Gordon Institute of Business Science
University of Pretoria

Harnessing digital technologies to enhance innovation outcomes through virtual networks in MNEs

24126162

A research project submitted to the Gordon Institute of Business Science, University of Pretoria, in partial fulfilment of the requirements for the degree of Master of Philosophy International Business.

24 November 2025

Declaration

I declare that this research project is my own work. It is submitted in partial fulfilment of the requirements for the degree of Master of Philosophy in Corporate Strategy at the Gordon Institute of Business Science, University of Pretoria. It has not been submitted before for any degree or examination in any other University. I further declare that I have obtained the necessary authorisation and consent to carry out this research.

24126162 24 November 2025

Abstract

Digital communication technologies facilitate increased efficiency and cost reduction in coordinating activities across global locations. These advancements also enable innovative business models that shift value creation and innovation to international networks. The implementation of virtual networks and digital tools has narrowed geographic gaps, mitigating risks associated with distance and underdeveloped infrastructure. However, MNEs face fast changing digital technologies and may struggle to translate digital technology investments into tangible innovation outcomes. Therefore, MNEs must develop the necessary capabilities to leverage these digital technologies to effectively manage their virtual networks and enhance innovation.

Digital tools have enabled globally dispersed organisations to connect across time and space, regardless of their geographic location. Organisations are developing digital strategies to create new business models, shifting costs and activities from their own to partners, complementors, customers, and other stakeholders at home or abroad. However, the understanding of how MNEs manage these virtual network relationships, through digital technologies, to enhance organisational innovation outcomes is fragmented. There has been extensive research on how digital technologies impact innovation, however literature on how digital technologies enhance innovation outcomes through MNEs virtual networks is limited.

The purpose of this study is to explore how digital technologies enhance innovation outcomes through virtual networks of MNEs. An interpretive, exploratory, phenomenological approach was adopted for this study. Twelve semi-structured interviews were conducted from four grouped clusters (automotive, banking, telecommunications, and manufacturing). These groupings allowed for ease of comparison, but the participants were from eight MNEs based in South Africa, as a host or home country.

The research outcomes were found to have similarities with literature in most of the themes identified. However new themes were identified from the empirical data, these were ‘create a virtual experimental environment’ and ‘virtual networks as enablers of customer driven innovation’. This study has contributed to literature by adding empirical evidence to existing literature, and refinement through potentially new insight on how virtual networks enhance innovation outcomes, enabled by digital technologies. Further, a conceptual framework was developed on the key considerations of understanding how digital technologies enhance innovation outcomes through virtual networks in MNEs. Recommendations to management and for future research were included.

Keywords:

Virtual networks, digital technologies, digital capabilities, innovation outcomes, customer driven innovation

List of abbreviations

AI: Artificial intelligence

AR: augmented reality

CRM: customer relationship management

ERP: Enterprise resource planning

GPT: General purpose technology

HCM: Customer relationship management

IB: International Business

ICT: Information, communication technologies

IT: Information technology

FDI: Foreign direct investment

MNEs: Multinational Enterprises

R&D: Research and Development

RQ: Research question

VR: Virtual reality

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1. Introduction

This chapter provides the background and context of this research study by first explaining the business and theoretical relevance, explaining why this study was conducted. The chapter also outlines the research questions and research gap that the study aims to answer. The study aims to explore how digital technologies enhance innovation outcomes through virtual networks in multinational enterprises (MNEs). The purpose of this study is clearly defined in this chapter. Further the chapter outlines how this specific study aims to contribute to the existing body of knowledge of virtual networks in international business and digital technologies domains. This chapter will describe the theoretical and physical scopes covered by the study. Finally, this chapter will present an overview of the report's structure, outline its organisation and summarise the content addressed in the following chapters.

1.1. Business relevance

Digital communication technologies enable greater efficiency and lower costs when coordinating activities across different locations worldwide; these technologies also support new business models that transfer innovation and value creation to global networks (Autio et al., 2021). In the Africa, vast geographical distances and underdeveloped infrastructure pose challenges for businesses, thus MNEs operating in such contexts can leverage digital technologies to bridge this gap (Adomako et al., 2024).

Virtual teams enable globally dispersed organisations to overcome geographical and temporal barriers (Hung et al., 2021). Additionally, digitalisation also enables organisations to tap into new markets and adapt accordingly to changing consumer preferences (Zahra & Mudambi, 2025). MNEs invest in digital infrastructure (virtual platforms and virtual marketplaces, for example) and data analytics which enable them to connect to customers they could previously not reach and offers understanding of these customer behaviours, preferences, and trends (Adomako et al., 2024).

MNEs have relied on physical cross-border mobility (such as expatriate assignments and international travel) however they are now moving towards location-based expertise and virtual collaboration models (Froese et al., 2025). Strong team management boosts knowledge sharing for innovation (Hung et al., 2021), and leaders with global identity and cultural intelligence make virtual teams more effective (Froese et al., 2025). Robust networks, subsidiary competencies, and technological advancements in MNEs

contribute to innovative performance (Dahms et al., 2020). However , the challenge in Africa is sourcing of highly skilled IT talent; this requires strong partnerships with strong integrators of cloud service providers to get support on their cloud migration while simultaneously upskilling existing team (Blumberg et al., 2024).

While digital communication technologies reduce monitoring and coordination costs, enabling dispersed operations, MNEs must develop specific capabilities to manage the inherent risks of virtual networks (Luo, 2021; Zeng et al., 2023). MNEs invest in digital technologies but many struggle to translate these investments into tangible innovation outcomes (Luo, 2022b) or returns on investments. The challenge for MNEs is how to effectively use the adopted digital technologies to achieve better innovation outcomes. Additionally, when technology is properly applied, it can enhance decision-making, create opportunities for upskilling and reskilling, encourage cross-functional collaboration, attract top talent, and increase workplace safety (Gregolinska et al., 2022).

Most MNEs find themselves participating in virtual business ecosystems and digital platforms, exposing themselves to third party suppliers, service providers, and subcontractors (Luo, 2022a). This kind of outsourcing of IT services unlocks company efficiencies and innovation. The disadvantage of this is that organisations may struggle to ensure business security and resilience (Lewis et al., 2025). Further, digital platforms foster cocreation, collaborative innovation, and boost MNEs' absorptive capacity, supporting technological progress in their networks (Zahra & Mudambi, 2025). Effectively managing digital risks necessitates robust information processing capabilities and advanced digital intelligence, that is, the capacity to identify valuable opportunities and mitigate risks using digital tools (Luo, 2022). Organisations must develop the ability to access, coordinate, and leverage (Fleury et al., 2024) virtual network resources for competitive advantage (Bhandari et al., 2023; Fleury et al., 2024) highlighted that data-related investments for technology infrastructure are essential.

To effectively capitalize on big data, organisations require data scientists with combined expertise in data analytics and IT, while managers must possess a deep understanding of how and where to apply the insights generated by these data specialists into organisational goals (Ahi et al., 2022). Further, organisations must develop country specific virtual ecosystems capable of transferring and protecting data in compliance with local or host countries regulations (Furr et al., 2022). An important data related challenge

within global virtual ecosystems is the need to exchange data across different coding languages (Furr et al., 2022).

Therefore, MNEs must develop capabilities of managing these virtual networks to exploit their benefits in the global context. MNEs further need to build digital capabilities to manage the technological developments and have employees that are ready to work in the digital context, thus improving competitive advantage (Fleury et al., 2024). Digital transformation should be guided by value rather than technology; it is essential to establish a clear connection between opportunities, business challenges, or capability requirements and their tangible value (Gregolinska et al., 2022). Lastly, MNEs need to build capabilities to best exploit digital technologies and virtual networks to improve their innovation outcomes (Du et al., 2023).

1.2. Theoretical relevance

Advancements in digital technologies have enabled MNEs to optimise certain operations and enhance collaboration with external partners (Zeng et al., 2023). These advancements have facilitated the distribution of activities and resources across multiple locations, simplified the separation of ownership from management, and promoted the growth of global value chains (GVCs), international platforms, and business ecosystems (Fleury et al., 2024). As a result, organisations are developing digital strategies to create new business models, shifting costs and activities from their own to partners, complementors, customers, and other stakeholders at home or abroad (Meyer et al, 2023). Consequently, MNEs continuously create global networks, external and internal, and use these as ways of acquiring organisational knowledge and experiential insights that support their innovation activities (Fleury et al., 2024).

Digital tools have enabled globally dispersed organisations connect across time and space, regardless of their geographic location (Hung et al.,2021). The ability to replace face-to-face interactions through virtual teams, increases the resilience of MNEs during disruptive events (Dachs et al., 2024). There has been an increase in academic discussions regarding how multinational enterprises (MNEs) innovate from both network and knowledge perspectives (Du et al., 2023). Literature on virtual networks in MNEs focused on general networks and how they are impacted by digital technologies, not specifically virtual networks (Dahms et al., 2020) . The concept of virtual networks includes cross-border R&D alliances (Bouncken et al., 2023), global value chains (GVCs) (Ahi et al., 2022), and internal MNE virtual teams (Hung et al., 2021), all of which depend on digital technologies such as the Internet, artificial intelligence, big data analytics, and

cloud computing (Ahi et al., 2022). Digital technologies will continue to facilitate coordination and knowledge exchange within MNEs and provide new opportunities for products, services, and processes (Dachs et al., 2024).

The extant literature highlighted the importance of adoption of digital technology; however, the focus should be on restructuring capabilities, organisational design, culture, and managing internal tensions that exist (Meyer et al., 2023). Hung et al. (2021) studied the management of virtual teams extensively, suggesting virtual team leadership, trust, and team processes as ways of achieving team outcomes. Global virtual team leaders with global identity, cultural intelligence, international experience appeared to lead virtual teams more effectively (Froese et al., 2025) . In their empirical study, Dahms et al. (2025) found that digital capabilities can drive innovation performance when combined with strong inter-organisational network relationships. Therefore, it is imperative for MNEs to continuously build strong networks to facilitate flow of knowledge for innovation, using digital technologies within their networks. Achieving effective utilisation of these networks involves developing digital skills to manage digital vulnerabilities, which may require specialised skills and adjustments of management team (Teece, 2025).

Facilitating collaboration through digital technologies may lead to difficulties in communication, especially across the different cultures and time zones (Zahra & Mudambi, 2025). Froese et al. (2025) observed that cultural differences within global virtual teams reduced communication effectiveness and increased intra-team conflict. Further Vuchkovski et al. (2023) highlighted social and psychological consequences of isolation, importance of familiarity in virtual teams that could result in lower levels of belonging, thus less collaboration among members. Zahra and Mudambi (2025) also highlighted isolation of workers which may impact their engagement and contribution.

Digital platforms foster cocreation, collaborative innovation, and boost MNEs' absorptive capacity, supporting technological progress in their networks (Zahra & Mudambi, 2025). Business ecosystems include supply chains, government regulatory organisations, stakeholders, and other entities that share similar products or services (Cha, 2020). These organisations share assets like digital resources data interchange, shared virtual sales, shared network users, and other electronic linkages (Cahen & Borini, 2020). However, the effects of digitalisation and virtualisation on technology transfer in strategic partnerships remain largely unclear, despite their significant roles (Sarala et al., 2025). Further, Zeng et al. (2023) emphasised the need for empirical investigations on how

MNEs control and coordinate internal and external relationships because of the fundamental changes enabled by digitalisation.

Digital Connectivity makes intra-organisation collaboration, sharing, and learning easier, productive, and efficient (Luo, 2021). Digital connectivity encompasses integration of digital technologies (ICT, cloud services, IoT, AI, blockchain, and data analytics) into all functions and locations of the MNEs, and generating intelligence that fosters constant innovation, and flat decision making (Luo, 2022a). Consistent with Teece (2025), effective coordination among interdependent and geographically dispersed subsidiaries requires robust dynamic capabilities in orchestration and integration to ensure coherence and agility within global operations. Digital connectivity viewed as a double-edged sword, functioning both as disruptor and an enabler of global business transformation (Luo, 2022a; Teece, 2025). Teece (2025) highlighted the introduction of systemic risks into the digital supply chains, accelerated competition, by enabling new rivals.

Further, MNEs, particularly those "going digital", often face challenges in addressing legacy systems and organisational inertia during the process of adopting new digital strategies (Fleury et al., 2024). Digital connectivity and integration are frequently impeded by structural inertia and bureaucratic challenges, which can be difficult to overcome (Luo, 2021). As a result, the integration of new digital technologies into legacy systems can be complex, leading to operational disruptions that strain resources and distract MNEs from new initiatives (Zahra & Mudambi, 2025). Therefore, a key aspect of digital architecture is how effectively an MNE integrates and leverages its digital technologies (Luo, 2022b).

For traditional MNEs to undergo digital transformation, they must adopt business processes and practices that enable them to compete in the digital world (Meyer et al, 2023). In addition, to leverage advanced digital technologies, MNEs need to have resources and capabilities in place, such as human capital, tangible resources, organisational strategy, organisational culture, clear outcomes (Ahi et al., 2022), and development of common values (Autio et al., 2021). Furthermore, achieving effective utilisation of these networks involves developing digital skills to manage digital vulnerabilities, which may require specialised skills and adjustments of management team (Teece, 2025).

Lastly, digital technologies transform how MNEs organise for value creation, delivery, and capture, with direct impact innovation outcomes in geographically dispersed network

(Autio et al., 2021). Innovation outcomes refer to the ability to create innovations along the dimensions of products and services, production methods and processes, patents, management or marketing practices (Dahms et al., 2020; Du et al., 2023). Digital technologies and virtual networks drive numerous innovation outcomes for MNEs by driving the development of new processes and new products (Fleury et al., 2024). These digital technologies and virtual networks also stimulate creation of new business models (Bouncken et al., 2023), expanding global market reach, and allows knowledge transfer and collaboration across geographical boundaries (Autio et al., 2021). By linking global resources and easing knowledge transfer challenges, R&D becomes more accessible in a "flatter world" (Ahi et al., 2022).

However, according to Bouncken et al. (2023), the acceleration of knowledge flows by virtual networks does not eliminate inherent challenges associated with tacit, experiential, or relational knowledge. For many forms of high-value knowledge, particularly in R&D contexts, digital tools may only partially substitute for the “handshake” relationships traditionally associated with deep collaboration and trust (Bouncken et al., 2023). Digital systems are often complex and organisation specific, so successful knowledge assimilation in cross-border R&D alliances relies on absorptive capacity, a shared digital identity, and minimal technological gaps between partners (Bouncken et al., 2023). When these conditions are absent, organisations risk falling into a “virtuality trap”, overestimating the ease of digital communication and underestimating the contextual knowledge needed to interpret information appropriately (Galkina et al., 2023). Although there is growing scholarly interest in impact of digitalisation on innovation, there is limited empirical understanding of how digital technology influences innovative outcomes through virtual networks of MNEs (Du et al., 2023).

1.3. Research questions

The overall research question was a response to a call for research from Du et al. (2023) on how digital technologies enhance innovation outcomes through virtual networks. Consistent with this, Zeng et al. (2023) argued that there is a need to understand multilevel studies that capture the MNEs control and coordination across different contexts, organisations, activities, and subsidiaries (Zeng et al., 2023). Therefore, RQ1 was

RQ1: How do MNEs develop and manage their virtual networks through digital technologies? (Du et al., 2022; Zeng et al., 2023)

It is important for MNEs enhance their capabilities to harness digital technologies (Fleury et al., 2024) available to them and choose the appropriate systems to support their needs. According to Luo (2022b), a key aspect of digital architecture is how effectively an MNEs integrate and leverage its digital technologies. In some instances, MNEs have excess of digital technologies which results in redundancy and incompatibility. Therefore, second research question was

RQ2: How do MNEs enhance their capabilities to harness use of digital technologies in virtual networks? (Fleury et al., 2024)

Digital technologies transform how MNEs organise for value creation, delivery, and capture, with direct impact innovation outcomes in geographically dispersed network (Autio et al., 2021). Although significant progress has been made in digitalisation, more empirical research is needed to understand how virtual teams, virtual reality technologies, and wider digital infrastructures are transforming cross-border collaboration in R&D and innovation (Benito et al., 2022). In globally MNEs context, collaboration between geographically distributed subsidiaries and their local networks is important to acquire knowledge and transform it into innovation outcomes (Dahms et al., 2025). Dahms et al. (2025) refers to MNEs internal and external networks, digital competencies, digital capabilities as important in driving for innovation outcomes, however, their study does not explicitly refer to virtual networks. Therefore, it is important to understand how the MNEs virtual network relationship equally drive for innovation outcomes.

RQ3: How do MNEs' virtual networks and digital technologies enhance innovation outcomes? (Benito et al., 2022; Du et al., 2023)

The constructs identified in this study were developing virtual networks, managing virtual networks, enhancing capabilities to harness digital technologies, and innovation outcomes.

1.4. Research aims

The aim of this research study is to explore and gather new insights on how digital technologies enhance innovation outcomes through virtual networks of MNEs. Additionally, the aim of this research study was to develop a conceptual framework showing how MNEs, in emerging markets, can develop and manage their virtual networks, enhance their capabilities to harness digital technologies, to enhance inn ovation outcomes. This conceptual framework was developed at theme level.

1.5. Research contribution

The main contribution of this study is to add or refine academic insights on how digital technologies enhance innovation outcomes through virtual networks of MNEs. This will be done by potentially identifying new insights that may be potential refinement to the body of knowledge of MNEs and their virtual networks, using digital technologies. At the same time, this research will contribute to the extant literature by adding empirical evidence and confirming already existing body of knowledge. Further, this study will provide insights of how digital technologies enhance innovation outcomes through virtual networks of MNEs in Africa, Africa is an under explored context (Adomako et al., 2024). On that note, the study will contribute on how 'going digital 'MNEs use their networks to enhance innovation outcomes, facilitated by digital technologies. Most of the literature studies 'born digital' MNEs (Fleury et al., 2024). Lastly, the research will contribute by providing management some guidance of what to consider when they want to enhance innovation outcome through dealing with their virtual networks and digital technologies.

1.6. Research scope

1.6.1. Theoretical scope

The study is situated within the international business and digital technologies domains and explicitly addresses MNEs. Some of the literature was adopted from global strategy domain since the context of the study is MNEs. The scope of the study included exploring different kinds of virtual networks that MNEs participate in. The internal virtual networks explored in this study are between headquarters and subsidiaries and subsidiary to subsidiaries (Dahms et al., 2025). These internal virtual networks collaborate or transfer knowledge with the purpose of improving their innovation performance or innovation outcomes; these includes cross border R&D. The external virtual networks covered are part of the global value chains, whether suppliers or customers. The medium through which some of these virtual networks interact are digital technologies which have not been limited and include virtual marketplaces, open innovation platforms, and virtual business ecosystems (Fleury et al., 2024). This study examines how virtual networks, facilitated by digital technologies, contribute to improved innovation outcomes, particularly for multinational enterprises (MNEs).

1.6.2. Physical scope

This study is focused on MNEs operating in South Africa, where South Africa is either a home country or a host country to these MNEs. The scope is limited to traditional MNEs 'going digital', which have undergone or are still undergoing digital transformation. The

study does not cover born digital MNEs. The context of the study is not sector specific, data was collected from different sectors, this broadens the applicability and transferability of research findings (Singh et al., 2021).

Existing studies on MNEs internal and external networks and digital technologies have been extensively conducted in Europe (Dahms et al., 2020) and other parts of Asia (Dahms et al., 2025), however African countries are less presented in international business (IB) research (Adomako et al., 2024) . Further, an African research context is an interesting setting because of the high inflows of global foreign direct investment (FDI) and MNEs are establishing businesses in the continent, and the presence of emerging economies (Adomako et al., 2024). This could offer context-specific empirical evidence and contribute to the development or refinement of existing theories from an African perspective.

1.7. Structure of report

The rest of the report will be divided as follows:

Chapter 2 presents the literature review which argues and identifies research gap based on academic literature that exists. Chapter 3 presents the academic focus of the research by showing the research questions for the study. Chapter 4 outlines and justifies the research methodology employed in this study. The ethical consideration by the author will also be included in this chapter. Chapter 5 presents the findings of this study. Chapter 6 presents the discussion of the findings in relation to the academic literature that exists. Lastly, Chapter 7 serves as the conclusion of the study outlining the research outcomes and how they contribute to literature and industry. The authors conceptual framework for h study will be presented. In this chapter the overall limitations of the study will be included.

2. Literature Review

2.1. Introduction

This chapter outlines the extant literature on digital technologies, virtual networks, and their impact on innovation outcomes within MNEs. The chapter starts by exploring literature pertaining to sub-research question one, which seeks to understand how MNEs develop and manage their virtual networks. Subsection 2.2. covers how the different types of virtual networks that could exist within MNEs are developed. Sub-section 2.3. explores how MNEs manage the identified virtual networks through digital technologies. Section 2.2. and 2.3 respond to RQ1. Subsection 2.4 explores how MNEs enhance their capabilities to harness digital technologies. This subsection responds to RQ2 which explores how MNEs enhance their digital capabilities to harness digital technologies when managing their virtual networks. Subsection 2.5 explores the possible innovation outcome that may be because of virtual networks and digital technologies. This responds to RQ3. Finally, the chapter will present the conceptual framework showing how the constructs are said to relate from literature. Table 1 shows the roadmap illustrating the key topics to be explored in this chapter.

Table 1: Roadmap showing literature review chapter

Research question	**Main Headings**	**Subheading1**
RQ1. How do MNEs develop and manage their virtual networks through digital technologies? (Du et al., 2022; Zeng et al., 2023)	2.2. Developing virtual networks	2.2.1. Internal virtual networks
		2.2.2. External virtual networks
		2.2.3. Leveraging digital architecture
	2.3. Managing virtual networks	2.3.1. Implementing control mechanisms
		2.3.2. Develop digital connectivity intelligence
		2.3.3. Autonomy for subsidiaries
		2.3.4. Managing inertia & legacy
		2.3.5. Change Management

RQ2: How do MNEs enhance their capabilities to harness use of digital technologies in virtual networks? (Fleury et al., 2024)	2.4. Enhancing capabilities to harness digital technologies	2.4.1. Orchestrating virtual business ecosystems
		2.4.2. Developing big data capability
		2.4.3. Preparing human resource for digital context
RQ3: How do MNEs' virtual networks and digital technologies enhance innovation outcomes? (Benito et al., 2022; Du et al., 2023)	2.5. Innovation outcomes	2.5.1. Driving new business models
		2.5.2. Open innovation
		2.5.3. Streamlining R&D and reducing costs
		2.5.4. Facilitating knowledge transfer
2.6. Conceptual framework		
2.7. Chapter conclusion		

2.2. Developing virtual networks

Advancements in digital technologies are reshaping how organisations integrate their geographically dispersed strategic partners, specialised suppliers, and customers into complex structures known as global value chains (Ahi et al., 2022). Organisations are developing digital strategies to create new business models and shifting costs and activities from their own to partners, complementors, customers, and other stakeholders at home or abroad (Meyer et al, 2023). Advancements in digital technologies have enabled multinational enterprises (MNEs) to optimise certain operations and enhance collaboration with external partners (Zeng et al., 2023). Furthermore, these advancements have facilitated the distribution of activities and resources across multiple locations, simplified the separation of ownership from management, and promoted the growth of global value chains (GVCs), international platforms, and business ecosystems (Fleury et al., 2024).

There has been an increase in academic discussions regarding how multinational enterprises (MNEs) innovate from both network and knowledge perspectives (Du et al., 2023). Literature on virtual networks in MNEs focused on general networks and how they are impacted by digital technologies, not specifically virtual networks (Dahms et al.,

2020) . The concept of virtual networks includes cross-border R&D alliances (Bouncken et al., 2023), global value chains (GVCs) (Ahi et al., 2022), and internal MNE virtual teams (Hung et al., 2021), all of which depend on digital technologies such as the Internet, artificial intelligence, big data analytics, and cloud computing (Ahi et al., 2022). In their systematic literature review, Froese et al. (2025) identified three main areas of global virtual work research: global virtual teams (project-based collaboration), distributed work (routine tasks across sites), and digital communication infrastructure (tools and platforms for networking) as an enabler.

The extant literature highlights the importance of adoption of digital technology; however, the focus should be on restructuring capabilities, organisational design, culture, and managing internal tensions that exist (Meyer et al., 2023). Hence it is important to empirically explore how MNEs develop and manage virtual networks to make best use of digital technologies, thus achieving more innovation outcomes (Du et al., 2023).

2.2.1. Internal virtual networks

2.2.1.1. Leveraging Foreign Subsidiaries

Rapid technological advancements drove MNEs to change their design of MNE control and coordination of their subsidiaries (Zeng et al., 2023). The internal networks of MNEs consist of numerous interconnected units, each playing an integral role in the absorption, utilisation, and creation of knowledge within the organisation (Du et al., 2023). These intra-organisational (internal) networks are the primary channel for transferring and exploiting organisation-specific advantages across subsidiaries to drive global innovation performance (Dahms et al., 2025). Dahms et al. (2020) have studied how subsidiary units of MNEs can drive innovation through their local networks and bring knowledge into the MNEs. Dahms et al. (2020) observed that robust alliances, subsidiary competence, and technological advancement within MNE contribute significantly to innovative performance. Furthermore, Du et al. (2023) posits that literature has shown that MNE subsidiaries that have well-embedded social relationships with local partners in host country achieve more innovation.

2.2.1.2. Virtual teams

MNEs have relied on physical cross-border mobility (such as expatriate assignments and international travel) however they are now moving towards location-based expertise and virtual collaboration models (Froese et al., 2025). Virtual teams enable globally dispersed organisations to overcome geographical and temporal barriers (Hung et al., 2021).

Additionally, virtual teams are described to be teams with a working arrangement in which team members are geographically dispersed with limited face-to-face contact, working independently using electronic communication media to achieve common goals (Vuchkovski et al., 2023). The ability to replace face-to-face interactions through virtual teams, increases the resilience of MNEs during disruptive events (Dachs et al., 2024).

Hung et al. (2021) studied the management of virtual teams extensively, suggesting virtual team leadership, trust, and team processes as ways of achieving team outcomes. Global virtual team leaders with global identity, cultural intelligence, international experience appeared to lead virtual teams more effectively (Froese et al., 2025) . Furthermore, empowering team leadership and mentoring roles improved collaborative behaviours.

In their study Hung et al. (2021) explored the role of inclusive non-spatial proximity and knowledge sharing in fostering innovation performance of virtual teams through a survey from global enterprises from Taiwan and China. Their findings were that members shared organisational relationships can facilitate a comfortable organisational environment, which encourages knowledge sharing. Knowledge sharing was found to be a driving force for team members' intention to innovate (Hung et al., 2021); implying that the use of virtual systems within an MNE can promote innovation outcomes.

Hung et al. (2021) noted that inclusivity is crucial in virtual teams, as considering members' organisational and cultural backgrounds helps build trust and relationships more easily when backgrounds are similar. Further, a positive inclusive environment can enhance team collaborative performance. Therefore, when working in virtual teams, managers should create an inclusive atmosphere in which success or failure are regarded a collective outcome of a group, while recognising all team members' contributions (Hung et al., 2021).

In their empirical study, Vuchkovski et al. (2023) found that the organisation had to create a centralised system and solid infrastructure to enable digital transformation process and provide equal access to all employees, to facilitate communication, information and knowledge sharing. These authors recommended provision of communication training workshops as part of the digital transformation process; this could avoid leaving virtual team members misunderstood. In addition, Froese et al. (2025) emphasised on how information about national cultural contexts or cultural cues can offset the negative perceptions that other team members may have on violations of professional email conversations. Furthermore, Zahra and Mudambi (2025) noted that facilitating

collaboration through digital technologies may lead to difficulties in communication, especially across the different cultures and time zone. In closing, Froese et al. (2025), observed that cultural differences within global virtual teams reduced communication effectiveness and increased intrateam conflict.

Vuchkovski et al. (2023) further highlighted social and psychological consequences of isolation, importance of familiarity in virtual teams that could result in lower levels of belonging, thus less collaboration among members. Zahra and Mudambi (2025) also highlighted isolation of workers which may impact their engagement and contribution. However, Zahra and Mudambi (2025) referred to temporary workers who may be hired to work on projects through virtual collaboration platforms, and not MNE global virtual teams.

2.2.2. External virtual networks

External networks for MNEs are subsidiary relationships with host country actors, essential for accessing new ideas and driving innovation (Dahms et al., 2025). According to Froese et al. (2025), MNEs, along with their contracted suppliers, educational institutions, developers for part of the typical context of global virtual networks; aim is to bring globally distributed expertise, knowledge exchange, cost reduction, R&D, and learning.

2.2.2.1. Virtual business ecosystems and digital platforms

Networks and partnerships formed in person can lead to the development and expansion of digital user networks, while online relationships can also become in-person interactions (Galkina et al., 2023). A virtual business ecosystem is made up of organisations located in different countries that work together to produce, deliver, and develop products, technologies, and services for international markets (Luo, 2021). These organisations participate in dynamic interactions and interdependencies, establishing a sophisticated network that facilitates value creation and fosters competitive advantage on an international level (Luo, 2021). However, virtual ecosystems often require co-specialisation which may be complex across global boundaries due to different regulator and technical standards (Furr et al., 2022).

Business ecosystems may be defined “as economic community in which individual organisations interact with each other and co-evolve their capabilities by adjusting themselves with the directions of one or more central organisation,” (Cha, 2020, pp 3).

Digital platforms foster cocreation, collaborative innovation, and boost MNEs' absorptive capacity, supporting technological progress in their networks (Zahra & Mudambi, 2025). Business ecosystems include supply chains, government regulatory organisations, stakeholders, and other entities that share similar products or services (Cha, 2020).

Today, most organisations are affected by digital global platforms and ecosystems, becoming integrated into wider connected systems (Luo, 2022a). Virtual partnerships enable organisations to share digital assets, making it quicker and more efficient to attract and reach users or customers in new international markets (Cahen & Borini, 2020). The shared assets may include digital resources data interchange, shared virtual sales, shared network users, and other electronic linkages (Cahen & Borini, 2020). However, the effects of digitalisation and virtualisation on technology transfer in strategic partnerships remain largely unclear, despite their significant roles (Sarala et al., 2025).

Galkina et al. (2023) conducted an empirical case study that identified three mechanisms for the coexistence of network relations of international digital platform organisations in both physical locations and digital environments: simulation, reinforcement, and separation. These authors focused their study on the network approach, which emphasises the need for coexisting networks in both physical and digital spaces. Galkina et al. (2023) referred to the Uppsala model, emphasising the need for physical presence for long lasting, trustworthy relationships to react to any kind of barriers when entering new markets.

Cahen and Borini (2020) highlighted the importance of cross-cultural programming skills (programming prowess and cultural sensitivity) that enable organisations to design interfaces for global markets without rebuilding the application for every new local market. Further, these critical skills were identified in the empirical case study research by Cahen and Borini (2020), which evaluated specific capabilities that enabled organisations in internationalisation process, especially those providing digital products. Cross-cultural programming skills are defined as the ability to adapt user interfaces to different cultural preferences, generate value for diverse users, participate in shared digital systems that involve multiple digital companies through application programming interface (API), and plug and play their product into standardised virtual marketplace accessible to users worldwide (Cahen & Borini, 2020). Cha (2020) emphasised that when it comes to business ecosystems, cultural diversity is very important; what matters is complementarity and heterogeneity due to diversity.

2.2.3. Leveraging digital architecture

The efficiency of global operations can be enhanced through the implementation of advanced digital architectures, such as enterprise resource planning (ERP), human capital management (HCM), customer relationship management (CRM), global talent banks, data management platforms, global intranets, cloud computing, and data analytics (Luo, 2021). Digital architecture is a strategic framework that defines how an organisation designs, integrates, and evolves its digital capabilities to deliver business value. MNEs must build strategic digital architecture within their subsidiaries and headquarters to nurture intra-organisation collaboration sharing, and learning (Luo, 2021). Digital architecture refers to the blueprint for digital transformation. It aligns technology investments with strategic goals and enables organisations to adapt quickly to market change (Luo, 2021). Furthermore, in their literature review, Luo and Zahra (2023) highlighted the importance of the digital infrastructure to support interoperability, integration, extension or scalability. The scalability of digital architecture enables relatively small central headquarters to control and coordinate globally dispersed operations (Autio et al., 2021). The digital architecture should be modular and transferable to support fast global expansion and adapt to the specific needs of each host country (Luo, 2022).

Digital communication technologies enable greater efficiency and lower costs when coordinating activities across different locations worldwide; these technologies also support new business models that transfer innovation and value creation to global networks (Autio et al., 2021). Additionally, digitalisation also enables organisations to tap into new markets and adapt accordingly to changing consumer preferences (Zahra & Mudambi, 2025). While digital communication technologies reduce monitoring and coordination costs, enabling dispersed operations, MNEs must develop specific capabilities to manage the inherent risks of virtual networks (Luo, 2021; Zeng et al., 2023).

Organisations also invest in simulation technologies, which involve creating model systems to describe and analyse their behaviours (Ahi et al., 2022). Furthermore, simulation technologies make it possible to study how complex processes behave in a virtual setting, helping to eliminate the need for expensive experiments with real systems or physical models (Ahi et al., 2022). These are usually used in for problem solving in production environment. According to Luo (2022b), a key aspect of digital architecture is

how effectively an MNE integrate and leverage its digital technologies. In some instances, MNEs have excess of digital technologies which results in redundancy and incompatibility.

2.2.4. Conclusion for how MNEs develop virtual networks

The literature demonstrates that MNEs develop virtual networks through the interplay of digital technologies, organisational restructuring, and new collaborative practices within internal and external boundaries. Advancements in digital tools, such as cloud computing, big data analytics, artificial intelligence, and collaborative platforms, have enabled MNEs to connect geographically dispersed subsidiaries, partners, suppliers, and customers into digitally mediated global value chains, international platforms, and business ecosystems. Extant literature emphasises that MNEs must redesign organisational structures, capabilities, and cultural norms to fully leverage virtual networks and realise innovation outcomes.

MNEs rely on foreign subsidiaries and global virtual teams as central ways of knowledge absorption, integration, and cross-border collaboration, internally. Subsidiaries embedded in host country networks contribute locally sourced knowledge that fuels innovation across the multinational system, while virtual teams enable These internal virtual networks depend on strong leadership, trust-building, inclusive team climates, and shared norms to overcome challenges related to cultural distance, communication breakdowns, and psychological isolation.

Externally, MNEs form virtual networks with diverse ecosystem actors, including suppliers, digital developers, educational institutions, and platform participants, facilitated by digital architectures and global platforms. These external relationships support co-creation, knowledge exchange, and access to distributed expert capabilities. Capabilities such as cross-cultural programming, modular digital architectures, and platform integration further enhance the ability of organisations to operate within digital ecosystems and penetrate global markets. Nevertheless, the literature highlights that the virtual partnerships introduces uncertainties around knowledge transfer, cultural compatibility, and the coexistence of offline and online network ties.

Digital architecture underpins both internal and external virtual networks by providing the foundational systems (ERP, CRM, API ecosystems, cloud infrastructures, and data platforms) that allow scalable coordination and interoperability across dispersed

operations. Effective virtual network development therefore requires MNEs to invest not only in technological infrastructures but also in strategic alignment, capability building, and adaptive organisational designs that mitigate the risks inherent in virtual collaboration.

MNEs develop virtual networks by combining digital technologies with redesigned organisational practices that enhance connectivity, collaboration, and innovation across global operations. While digitalisation expands the scope and speed of cross-border interactions, sustained value creation depends on organisations' abilities to manage cultural, structural, and relational tensions. Further empirical research is needed to understand how MNEs use virtual networks to enhance innovation. Further empirical research is needed to understand how MNEs use virtual networks to enhance innovation.

2.3. Managing virtual networks

2.3.1. Implementing control and governance

MNEs face various challenges that advanced technologies like blockchain, IoT, and big data analytics can help address by improving real-time supply decisions and enabling efficient data capture, storage, and sharing (Ahi et al., 2022). Ahi et al. (2022) highlighted a carefully drafted contract as a mechanism for governance and management of virtual value chain actors, since this lowers the cost of control.

Furthermore, digital risks associated with part taking in ecosystems may arise because of the greater need of information processing (Luo, 2022a). Some examples may be information processing policies between host countries and home country, or even with foreign ecosystem members. Effectively managing these risks necessitates robust information processing capabilities and advanced digital intelligence, that is, the capacity to identify valuable opportunities and mitigate risks using digital tools (Luo, 2022). Organisations must develop the ability to access, coordinate, and leverage (Fleury et al., 2024) these network resources for competitive advantage (Bhandari et al., 2023; Fleury et al., 2024).

Galkina et al. (2023) emphasised that digital mistrust due to the absence of actual human interactions in some virtual relationships like digital platforms (or innovation platforms). According to Meyer et al. (2023), platform owners are responsible for establishing access and control rules, providing incentives to guide participant actions, and designing systems and interfaces that enable effective communication. Additionally, blockchain contracts help reduce risks, uncertainties, and transaction costs throughout the value

chain by offering increased assurance, decreasing information asymmetry, and providing real-time data (Ahi et al., 2022).

Managing global platforms involves balancing value creation versus capture (Furr, 2022) and integrating global network effects with local market adaptation in governance and ecosystem design (Meyer et al., 2023). Managing global platforms involves balancing value creation versus capture (Furr, 2022) and integrating global network effects with local market adaptation in governance and ecosystem design (Meyer et al., 2023). Effective management requires integrating global standards with modular frameworks that enable adaptability and foster dynamic, loosely connected partnerships (Zeng et al., 2023).

2.3.2. Develop digital connectivity intelligence

Digital connectivity enhances organisation and sharing within MNEs, facilitating the coordination of global tasks among foreign units (Luo, 2021). Furthermore, digital connectivity keeps foreign subsidiaries updated, allows executives to monitor real-time developments, and promotes collaboration across international subsidiaries (Luo, 2021). Luo (2022) defined digital connectivity as the savviness of an organisation in interlocking connectivity technologies, connectivity architecture, and connectivity intelligence. Digital Connectivity makes intra-organisation collaboration, sharing, and learning easier, productive, and efficient (Luo, 2021). Digital connectivity encompasses integration of digital technologies (ICT, cloud services, IoT, AI, blockchain, and data analytics) into all functions and locations of the MNEs, and generating intelligence that fosters constant innovation, and flat decision making (Luo, 2022a). Furthermore, digital connectivity relies on digital platforms, ICT, internet and intranet access, as well as technologies like big data, cloud services, and data analytics (Luo, 2022a).

Furthermore, digital connectivity and integration require MNEs to develop advanced capabilities, architectural, and organisational structures to enable the mobilisation, deployment, and reconfiguration of resources between frontline subsidiaries and hubs in different countries (Luo, 2021). As frontline subsidiaries or hubs often operate with distinct mandates and context-specific strategic objectives, it is increasingly challenging for them to identify complementary competencies and coordinate activities effectively with other units (Luo, 2021). Consistent with Teece (2025), effective coordination among interdependent and geographically dispersed subsidiaries requires robust dynamic capabilities in orchestration and integration to ensure coherence and agility within global operations.

Additionally, centralized governance allows headquarters to coordinate and leverage the strengths of foreign subsidiaries across the MNE and its wider ecosystem, reducing the risk that internal subsidiaries or external partners make decisions that misallocate the MNE's resources or activities(Zeng et al., 2023). Furthermore, by streamlining information flows and enhancing process efficiency, centralization also accelerates the utilisation and implementation of subsidiary-specific advantages (Zeng et al., 2023).

Digital connectivity viewed as a double-edged sword, functioning both as disruptor and an enabler of global business transformation (Luo, 2022a; Teece, 2025). Teece (2025) highlighted the introduction of systemic risks into the digital supply chains, accelerated competition, by enabling new rivals. Therefore, leveraging the potential of digitalisation requires the development of common values and norms (Autio et al., 2021) . Luo (2022) noted that some MNEs invest in digital technologies but are unable to improve corporate performance; this could be due to the lack the of ability to integrate various digital technologies and to optimise a digital connectivity architecture within the organisation and customers. Consequently, Zeng et al. (2023) emphasised the need for empirical investigations on how MNEs control and coordinate internal and external relationships because of the fundamental changes enabled by digitalisation.

2.3.3. Autonomy for subsidiaries

Digital technologies give headquarters detailed data on global subsidiaries, allowing for greater centralized decision-making and control, reducing subsidiary autonomy (Meyer et al., 2023). Additionally, access to global data also helps innovation managers drive further innovation. While digital technologies enable the geographic distribution of activities and resources, they also reinforce interdependencies, thereby increasing the need for control and coordination by the MNE headquarters (Zeng et al., 2023). Furthermore, Zeng et al. (2023) argued that centralising and standardising routine activities across subsidiaries, or global value chains, or any collaborating organisation, can enhance overall efficiency, when facilitated by digital technologies.

In line with this, Álvarez et al. (2024) highlighted that innovative MNEs with greater R&D intensity tend to internationalise via foreign direct investment, granting a higher degree of autonomy to their subsidiaries. However, larger MNEs that expand internationally through exports and subsidiary growth typically exercise increased control over their foreign subsidiaries (Álvarez et al., 2024). Álvarez et al. (2024) emphasised on the fact that control and autonomy of MNE subsidiaries varies across the internationalisation strategy employed. Benito et al. (2022) recommended that distribution of decision-

making power so that key information is accessible, enabling the entire organisation to benefit from exploiting the opportunities offered by local contexts. Therefore, the strategic challenge for MNEs remain to use digital technologies to balance control with autonomy, achieving global efficiency and encouraging local innovation (including entrepreneurship) (Meyer et al., 2020).

Alternatively, digital technologies and virtual networks are enabling the emergence of new business models, such as business platform ecosystems, which are characterised by openness and self-organisation (Cha, 2020). In digitally enabled ecosystems, a multilateral alignment of partners replaces the traditional hierarchical control found in MNEs (Spaniol & Rowland, 2022). Hence, the emphasis MNEs assign to integrating activities across geographically dispersed subsidiaries, may be less significant in the context of business ecosystems that utilize technological platforms and virtual networks (Cha, 2020). This results in the need for decentralisation of authority or disintegrated organisations when it comes to business ecosystems (Cha, 2020).

2.3.4. Managing inertia and legacy

MNEs, particularly those “going digital”, often face challenges in addressing legacy systems and organisational inertia during the process of adopting new digital strategies (Fleury et al., 2024). Legacy systems refer to existing systems, processes, cultural norms, and past investments, while inertia represents resistance for adaptation to change (Furr et al., 2022). Fleury et al. (2024) found that data management had a low path coefficient in their empirical study of “going” digital MNEs; they attributed challenges that traditional MNEs' face in integrating legacy system data and manual processes with newer machine-generated data. Further, Fleury et al. (2024) suggested to resolve this requires data-related investments for technology infrastructure. Digital connection and integration are often hampered by structural inertia and bureaucratic challenges, which are difficult to overcome (Luo, 2021). As a result, the integration of new digital technologies into legacy systems can be complex, leading to operational disruptions that strain resources and distract MNEs from new initiatives (Zahra & Mudambi, 2025).

2.3.5. Change Management

Organisations undergoing adoption of virtual teams have introduced change management capability; this is the ability to innovate the organisation’s direction, processes, structure, and resources to meet digitally changing needs of external and internal customers (Vuchkovski et al., 2023). In their study on how organisations which

underwent virtual adoption due to global nature of the pandemic, (Vuchkovski et al., 2023), found that the organisations in their samples introduced new change roles which require change management capability.

In their empirical study, Bhandari et al. (2023) found results that align with existing research on digitalisation, highlighting organisational change management as a key factor influencing the relationship between digitalisation and performance. These authors also noted that successful change management, which embeds digital transformation within an organisation, leads to greater efficiency and improved effectiveness.

Vuchkovski et al. (2023) identified openness to change as a key factor in successful digital transformation. Teece (2025) added that to achieve strategic change depends on previous transformations that fostered a culture open to change.

2.3.6. Conclusion of how MNEs manage virtual networks

The literature demonstrates that managing virtual networks in MNEs requires a multilayered integration of governance mechanisms, digital connectivity intelligence, subsidiary role configuration, legacy renewal, and change management capabilities. Advanced digital technologies, such as blockchain, cloud infrastructures, IoT, and data analytics, enable MNEs to coordinate dispersed subsidiaries, improve information processing, and reduce transaction costs. However, digital technologies introduce new risks, higher interdependencies, and increase the need for sophisticated digital intelligence and dynamic orchestration capabilities.

Effective management depends on MNEs' implementing control and coordination mechanisms, achieving an optimal balance between global standardisation and local autonomy, and fostering trust within digitally mediated contexts. At the same time, digital transformation requires organisations to address legacy system limitations and organisational inertia by making targeted strategic investments and demonstrating robust change management capabilities. MNEs that effectively align these components are well equipped to utilise virtual networks to drive innovation, enhance responsiveness, and achieve competitive advantage within their globally distributed operations.

2.4. Enhancing capabilities to harness digital technologies

2.4.1. Orchestrating virtual business ecosystems

An orchestration capability refers to an organisation's ability to pursue opportunities by assembling, organising, and integrating resources from global markets, partners, and within the company, relying on tacit expertise and process knowledge (Luo & Zahra, 2023). Furthermore, orchestration relies on recognising and managing the interdependencies within MNEs and with its external partners. The ability of MNEs to quickly assemble and disband teams based on project needs adds to operational agility, allowing them to respond quicker to market changes and opportunities.

Business virtual ecosystem orchestrators define the relevant ecosystem architecture and convince others to join (Furr et al., 2022). Furthermore, MNEs assemble their customer value propositions by orchestrating specialised organisations(partners) that produce increasingly specific intermediate goods and services (Benito et al., 2022). Ecosystem orchestration is beneficial across industries, but it proves especially effective in digital environments, where combining digital products to gain advantages is typically easier than with traditional products (Furr et al., 2022).

For platform digital organisations, successful internationalisation depends on developing and upgrading ecosystem-specific advantages to co-create value with external partners and keep interests aligned (Meyer et al., 2023). Digital platforms feature multiple layers of connections, both within and between platforms (Fraccastoro et al., 2025). Business ecosystems require trust which can be established using shared standards, contract rules, and modularity of the platforms (Spaniol & Rowland, 2022).

Participating in a collaborative business ecosystem enables organisations to distribute the costs associated with delivering goods and services among various partners while gaining access to capabilities that may have previously been unavailable (Furr et al., 2022).

2.4.2 Developing big data analytics capability

As digital technologies and business virtual networks produce vast amounts of both structured and unstructured data by capturing, transmitting, storing, and analysing it to support decision making (Mubarak & Petraite, 2020). Organisations must leverage big data analytics capability to better coordinate activities with the internal and external virtual networks (Ahi et al., 2022). In addition, the discussions focus is on how

organisations can create value through big data analytics; existing literature examines data analytics using such as the resource-based view or the dynamic capabilities perspectives (Ahi et al., 2022). Therefore, it is imperative for organisations to learn how to handle the flow structured and unstructured data (Fleury et al., 2024).

Data was previously seen as borderless resource but now is subject to governance and regulatory constraints (Furr et al., 2022). As a result, organisations must develop country specific virtual ecosystems capable of transferring and protecting data in compliance with local or host countries regulations (Furr et al., 2022). An important data related challenge within global virtual ecosystems is the need to exchange data across different coding languages (Furr et al., 2022).

Furthermore, MNEs leverage digital technologies, including big data analytics, to amplify the effectiveness of their mobile resources (like digital data and skilled personnel) to promote corporate entrepreneurship (Zahra & Mudambi, 2025). To effectively capitalize on big data, organisations require data scientists with combined expertise in data analytics and IT, while managers must possess a deep understanding of how and where to apply the insights generated by these data specialists into organisational goals (Ahi et al., 2022).

By leveraging big data analytics, organisations can evaluate the reputation and reliability of suppliers, partners, and their virtual networks through an analysis of their historical performance, business portfolios, and collaborative efforts (Mubarak & Petraite, 2020). This approach helps to enhance the open innovation process of selecting suitable suppliers, partners, co-creators, or collaborators in virtual networks (Mubarak & Petraite, 2020). According to Teece (2025), digital platform can change the nature of businesses (locally and internationally) by lowering transaction costs in numerous ways. Integrating data-driven decision-making into global value chains helps MNEs and their ecosystems stay competitive (Fleury et al., 2024).

MNEs in emerging markets face specific difficulties in recruiting skilled people necessary to close the talent gaps required for big data analytics capability development (Fleury et al., 2024).

2.4.3. Preparing human resource to operate in digital context

For traditional MNEs to undergo digital transformation, they must adopt business processes and practices that enable them to compete in the digital world (Meyer et al, 2023). In addition, to leverage advanced digital technologies, MNEs need to have resources and capabilities in place, like human capital, tangible resources, organisational strategy, organisational culture and outcomes (Ahi et al., 2022). Digital human capital refers to individuals possessing knowledge, skills, and abilities related to digital technologies such as software coding, artificial intelligence, and machine learning (Grimpe et al., 2023).

Some studies argue that MNEs must develop digital dynamic capabilities (sensing digital opportunities, seizing via investments and reconfiguration routines) to create and sustain virtual networks that produce knowledge flows and innovation (Vuchkovski et al., 2023). In addition, ongoing improvement and regular experimentation encourage unique, exceptional capabilities, which also supports knowledge sharing and integration among various subsidiaries, strengthening overall knowledge-building processes (Teece, 2025). In their empirical study, Vuchkovski et al. (2023), asserts that building dynamic capabilities may transform virtual team challenges into organisational innovation like emergence of new roles, structural changes, new ways of learning etc. This frames capability development as a process requiring managerial routines, not just IT purchase. Dahms et al. (2025) asserted that digital capabilities facilitate the expression of internal expertise or enable collaboration with external sources of knowledge, allowing organisations to effectively and promptly address the needs of their local environment. In their empirical study, Dahms et al. (2025) found that digital capabilities can drive innovation performance when combined with strong inter-organisational network relationships. Furthermore, achieving effective utilisation of these networks involves developing digital skills to manage digital vulnerabilities, which may require specialised skills and adjustments of management team (Teece, 2025). Hence, there is emphasis for digital platforms or ecosystems now on distributed talent orchestration, where expertise is accessed and activated across geographies without physical relocation (Froese et al., 2025).

Dahms et al. (2020) empirically investigated how foreign-owned-subsidiaries networks, mediated by IT advances and competencies, impacts innovation performance for the specific subsidiary in the host country. They used subsidiaries in Singapore and Thailand, opposed to the extant studies within European countries. They empirically found out that the intra-organisation networks influence innovation performance, however only in

combination with high IT advancement. This study emphasises the need for management and competencies for IT advances for the networks to yield effective innovation outcomes. Dahms et al. (2025) argued that organisations facing rapid digital change should build robust digital skills to leverage agility, capabilities, and networks for faster innovation and better customer service.

Furthermore, achieving high innovation performance requires agile subsidiaries equipped with advanced digital capabilities that strategically leverage internal networks to efficiently transfer and exploit existing competencies within MNEs (Dahms et al., 2020; Dahms et al., 2025). Consequently, high IT advancement combined with strong inter-organisational network relationships can drive positive innovation outcome. In their empirical study, Dahms et al. (2020) concluded that for superior innovation performance, MNE organisations IT advancements, competencies, and strong external or internal networks.

The objective is the ability to attract, recruit, develop, and motivate highly skilled workers who can solve complex problems and utilize data (Fleury et al., 2024). In their empirical study, Montero Guerra et al. (2023) found that digital transformation has a positive impact on the management, attraction, and retention of talent. However, developing a digital mindset as part of strategic thinking helps organisations navigate a changing digital landscape and avoid disruptive threats, such as war for talent (Zahra & Mudambi, 2025). Consequently, the demand for high technical skills, including data analytics and engineering, suggests that organisations may not be able to fully satisfy their talent requirements for digital transformation due to a scarcity of such skills (Montero Guerra et al., 2023).

To address this gap, digitalisation makes it easier for MNEs to access and integrate temporary knowledge workers (such as software developers or global nomads) into global teams using virtual collaboration platforms and project management tools (Zahra & Mudambi, 2025). Furthermore, MNEs can leverage global freelance expertise in areas of internal skill deficiency, offering a more cost-effective, flexible, and agile alternative to traditional in-house talent (Luo, 2021).

Virtual reality (VR) and augmented reality (AR) are gaining attention as strategic tools that MNEs can leveraged for global training, as they eliminate the need for physical presence (Ahi et al., 2022). MNEs leverage virtual reality to enhance cross-cultural training, by immersing employees in simulated environments that allow them to engage with and experience the communication styles and behaviours characteristic of different

cultures (Ahi et al., 2022). Consequently, these technologies support simulations which enhance formal training that covers intercultural knowledge and experiential learning (Froese et al.,2025); this strengthens global collaboration and workforce integration.

2.4.4. Conclusion for enhancing capabilities to harness digital technologies

To enhance digital capabilities in order to harness the use of digital technologies, three themes were explored: business ecosystem orchestration, developing digital big data analytics capability, and preparing human capital for operating in a digital context. Effective orchestration of business ecosystems enables MNEs to mobilise distributed resources and co-create value within interconnected digital platforms, supported by shared standards, trust, and modular architectures. Such orchestration enhances organisational agility by allowing MNEs to rapidly configure global teams and leverage partner capabilities across virtual networks.

It is important to develop robust big data analytics capabilities for navigating the growing volume of structured and unstructured data flows. When supported by the right talent and managerial understanding, analytics capabilities enhance coordination across virtual networks, improve partner evaluation, strengthen open innovation, and reduce transaction costs in global operations.

Digital transformation is fundamentally a capability-building process rather than only investing in digital technologies. Digital dynamic capabilities enable organisations to turn virtual collaboration challenges into innovation outcomes. Developing digital skills, fostering a digital mindset, and leveraging distributed talent pools all play central roles in enabling MNEs to innovate more rapidly, integrate global knowledge, and adapt to technological change. Advanced tools such as VR and AR further enhance global training, cross-cultural understanding, and workforce integration across dispersed teams.

This section highlighted three integrated set of organisational strengths that allow MNEs to effectively harness digital technologies. The ability to orchestrate ecosystems, exploit data-driven insights, and develop digitally skilled human capital positions organisations to navigate global uncertainty, enhance innovation performance, and sustain competitiveness in an increasingly digitalised international landscape.

2.5. Innovation outcomes

Digitalisation, considered a general-purpose technology (GPT), transforms how MNEs organise for value creation, delivery, and capture, with direct impact innovation outcomes in geographically dispersed network (Autio et al., 2021). Innovation outcomes refer to the ability to create innovations along the dimensions of products and services, production methods and processes, patents, management or marketing practices (Dahms et al., 2020; Du et al., 2023). Additionally, digital technologies and virtual networks drive numerous innovation outcomes for MNEs by driving the development of new processes and new products (Fleury et al., 2024). These digital technologies also stimulate creation of new business models (Bouncken et al., 2023), expanding global market reach, and allows knowledge transfer and collaboration across geographical boundaries (Autio et al., 2021).

2.5.1. Driving new business models

Digital technologies provide new opportunities for customer engagement and revenue generation, allowing MNEs to access new markets and continuously adapt to changing consumer preferences (Zahra & Mudambi, 2025). This has similarities with Bhandari et al. (2023), who argue that digital transformation equips organisations with capabilities driving new market expansion and creation, allowing for economies of scale. Furthermore, Furr et al. (2022) highlighted that when MNEs embark on digital transformation initiatives, they gain access to the information necessary to develop new business models and pursue emerging market opportunities.

Zahra and Mudambi (2025) observed that AI driven automation enhances productivity, reduces operational costs, and reallocates resources, thereby enabling MNEs to pursue innovative business models and new ventures. Moreover, artificial intelligence strengthens due diligence processes in MNEs' external venture activities by offering more comprehensive insights and facilitating more accurate assessments of potential investments (Zahra & Mudambi, 2025). In the same light, robots are valuable for their ability to automate tasks using sensors and machine learning (Ahi et al., 2022). Modern robots work more independently, adapt better, collaborate effectively, handle complex jobs, and interact with both humans and other robots (Ahi et al., 2022).

However, Volberda et al. (2021) cautioned that traditional hierarchies restrict organisation’s ability to create new business models; these organisations either need to modify or completely redesigned. To harness digitalisation's benefits, legacy structures

must be updated or redesigned to support agility (Volberda et al., 2021), collaboration, and decentralised decision-making (Luo, 2022a). In this context digitalization facilitates new business models that shift the locus of innovation and value creation to globally dispersed networks (Bouncken et al., 2023). Examples include the development of pure data-driven business models and digital platforms that disrupt established incumbents and previously localized service sectors (e.g., Uber and Airbnb) (Bouncken et al., 2023).

2.5.2. Open innovation

Digital platform networks (virtual networks) function as innovation hubs by enabling communication, creativity, and collaborations, and interactions that support economic activity forming global marketplaces (Ahi et al., 2022). Through these digital platforms, MNEs can orchestrate global collaboration and develop innovative ecosystems that overcome geographical barriers (Zahra & Mudambi, 2025). Such virtual networks collaboration is a key driver of digital globalization, improving innovation through open innovation platforms and global virtual networks (Luo, 2021). Furthermore, within these environments, digital trust becomes essential for sustaining cooperative innovation processes (Luo, 2021). By enabling reliable data sharing, smooth collaboration, and efficient knowledge flows among diverse stakeholders, digital trust strengthens open innovation performance and competitiveness of globally networked MNEs (Mubarak & Petraite, 2020).

2.5.3. Streamlining R&D Processes and Reducing Costs

Digitalization drives digital process innovation by enabling organisations to redesign and optimize their operations through the integration of advanced digital technologies (Fleury et al., 2024) . By automating and digitizing manufacturing and operational processes, MNEs achieve greater productivity and enhanced innovation performance (Mubarak & Petraite, 2020). Moreover, Industry 4.0 solutions facilitate global connectivity and remote coordination of R&D activities, streamlining knowledge transfer and collaboration through automated data exchange and interconnected digital systems (Bouncken et al., 2023).

The adoption of digital technologies such as AI, VR/AR, simulation, social media, and additive manufacturing (AM) for prototyping has strengthened the perception of a technology-driven acceleration in research and development (R&D) and innovation (Dachs et al., 2024). Papanastassiou et al. (2020) concluded that digital technologies enable virtual collaborative environments regardless of distance, particularly when

transferring and processing codified knowledge. Although there is growing scholarly interest in impact of digitalisation on innovation, there is limited empirical understanding of how digital technology influences innovative outcomes through virtual networks of MNEs (Du et al., 2023).

Digital tools enhance R&D efficiency by automating rule-based execution and repeated operational tasks (Furr et al., 2022), and further enable global connectivity of R&D (Bouncken et al., 2023). By linking global resources and easing knowledge transfer challenges, R&D becomes more accessible in a "flatter world" (Ahi et al., 2022) . Furthermore, innovation collaboration enables participants to share risks of launching new products, speed up their time-to-market, combine different skills and access financial resources and emerging technologies (Dahms et al., 2020). One of the objectives of digital adoption is to enhance innovation and agility, such as in new product development (Froese et al., 2025). Although significant progress has been made in digitalisation, more empirical research is needed to understand how virtual teams, virtual reality technologies, and wider digital infrastructures are transforming cross-border collaboration in R&D (Benito et al., 2022).

2.5.4. Facilitating knowledge transfer

Virtual environments, including collaborative platforms, cloud-based systems, global project spaces, and specialized digital tools, serve as key mechanisms through which organisations enhance speed, responsiveness, and learning (Autio et al., 2021). However, they also introduce new complexities, particularly when knowledge is tacit, experiential, or highly contextual (Froese et al., 2025).

According to Luo (2021) digitalisation lowers traditional barriers to knowledge mobility by reducing coordination costs, increasing transparency, and enabling seamless connectivity across the MNE network. Digital tools such as shared repositories, advanced communication platforms, and real-time dashboards facilitate the rapid diffusion of best practices, technological updates, and operational know-how across subsidiaries (Ahi et al., 2022). Big data analytics further reinforces this acceleration by enabling organisations to create, codify, and apply new knowledge quicker, often rendering existing knowledge obsolete more quickly, which becomes a critical feature of adaptability in volatile environments (Appiah et al., 2025).

Augmented reality (AR) and virtual reality (VR) enable globally dispersed experts to collaborate synchronously on product prototypes, perform remote troubleshooting, and deliver immersive training that accelerate competence development (Ahi et al., 2022). |n

a similar way, enterprise digital architecture (particularly ERP or CRM systems, API-enabled platforms, and cloud services) strengthens intra-organisation collaboration and learning while supporting real-time resource alignment and the rapid deployment of organisation-specific advantages across borders (Ahi et al., 2021). These digital architectures enhance the MNE's ability to sense, respond, and shape turbulent markets by accelerating communication and decision-making cycles across global teams (Zahra & Mudambi, 2025). Organisational agility enables organisations to rapidly seize new opportunities, reconfigure resources, and experiment with innovative responses under conditions of uncertainty (Dahms et al., 2025). Digital tools support these capabilities by facilitating objective, data-driven, and timely decision-making in increasingly complex global environments (Fleury et al., 2024).

However, according to Bouncken et al. (2023), the acceleration of knowledge flows does not eliminate inherent challenges associated with tacit, experiential, or relational knowledge. For many forms of high-value knowledge, particularly in R&D contexts, digital tools may only partially substitute for the "handshake" relationships traditionally associated with deep collaboration and trust (Bouncken et al., 2023). Digital systems are often complex and organisation specific, so successful knowledge assimilation in cross-border R&D alliances relies on absorptive capacity, a shared digital identity, and minimal technological gaps between partners (Bouncken et al., 2023). When these conditions are absent, organisations risk falling into a "virtuality trap", overestimating the ease of digital communication and underestimating the contextual knowledge needed to interpret information appropriately (Galkina et al., 2023).

E-leadership and digital capabilities play a decisive role in managing the relational and cognitive dimensions of virtual collaboration (Sarala et al., 2025). Leaders must cultivate shared norms, digital trust, and psychological safety to facilitate the transfer of tacit knowledge, orchestrate diverse teams, and prevent the pitfalls associated with over-reliance on ICT (Sarala et al., 2025).

2.5.5. Conclusion for innovative outcomes

Digitalisation allows MNEs to innovate through new business models, open innovation, and more efficient global R&D and knowledge transfer. However, much of the literature treats these outcomes as predictable results of technology adoption, offering limited insight into the organisational, cultural, and governance complexities that determine whether such innovations materialise. While digital platforms, virtual collaboration tools, and Industry 4.0 technologies enhance knowledge flows and global coordination, their

effectiveness depends on factors such as digital trust, ecosystem management, and the ability to integrate diverse actors across dispersed networks. Significantly, despite growing interest in digital transformation, there remains little empirical understanding of how MNEs use virtual networks to translate digital capabilities into sustained innovation outcomes.

2.6. Conceptual framework

Based on the literature review responding to the overall research question on how MNEs best use digital technologies to achieve innovation outcomes through virtual networks, the author created conceptual framework for this study. Figure 1 illustrates the author's conceptual framework for this study.

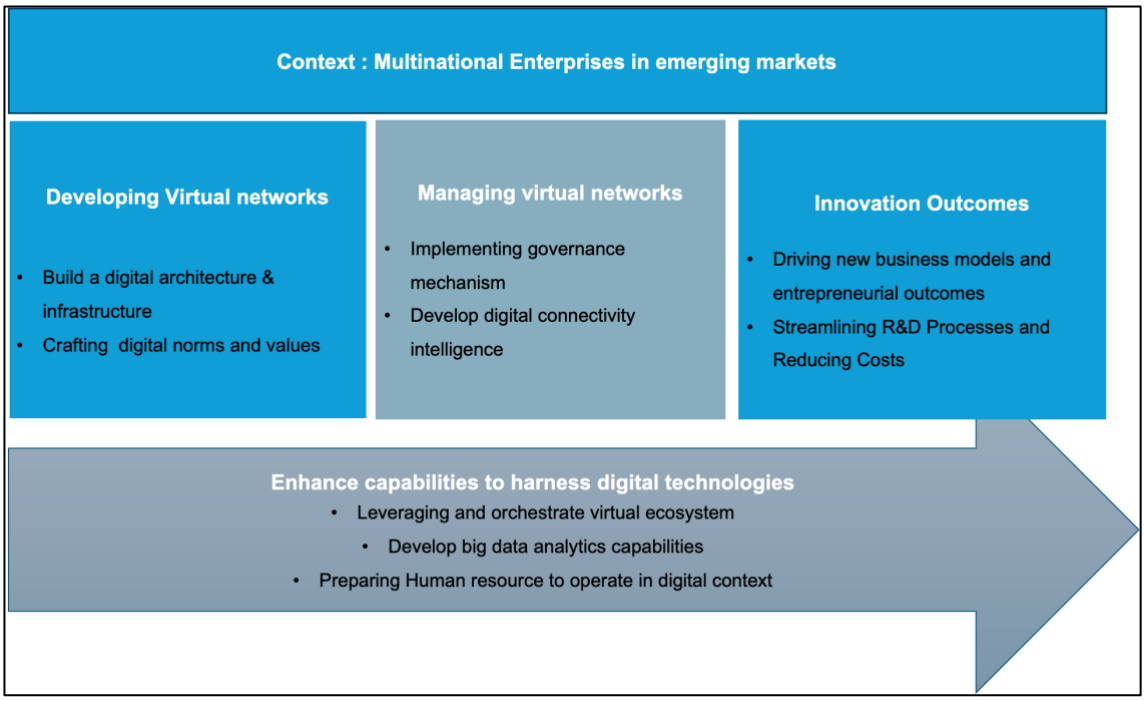


Figure 1:Conceptual framework (Authors own)

MNEs enhance their capabilities to harness digital technology use when managing their virtual networks. MNEs need to strategically manage their virtual networks (both external and internal) to achieve innovation outcomes of MNEs. Harnessing digital technologies and continuously enhancing capabilities may drive innovation outcomes through virtual networks.

2.7. Conclusion of chapter

The literature review was conducted to identify gaps in existing research and address the overall research question. Digitalisation emerges as a transformative force reshaping

how MNEs build, manage, and leverage virtual networks for innovation. Digital technologies and architectures enable organisations to connect dispersed subsidiaries, virtual teams, ecosystem partners, and platform actors into globally integrated but digitally mediated networks. The literature shows that to fully leverage virtual networks and digital technologies; organisations must undergo comprehensive digital transformation. This process necessitates investments in technology, adjustments to organisational structure, shifts in mindset, and changes in both leadership and personnel. Hence, the ability to translate this technological transformation into innovation outcomes depends heavily on organisational redesign, governance mechanisms, and the development of new capabilities.

MNEs must balance centralised control with local autonomy, cultivate trust and inclusivity within virtual networks, overcome legacy system constraints, and orchestrate increasingly complex business ecosystems. Dynamic capabilities like big data analytics, digital human capital, and ecosystem orchestration help coordinate interdependencies and support new business models, open innovation, and agile R&D.

The literature shows that digital technologies boost cross-border collaboration, but innovation depends on organisational, cultural, and relational contexts within virtual networks. Although significant advances have been made conceptually, there is still a limited empirical understanding of how MNEs structure, utilize, and leverage virtual networks to achieve ongoing innovation outcomes. The author put together a conceptual map based on the literature found, as a way of depicting their understanding of the research question and the literature presented.

Chapter 3 presents the research question development.

3. Research questions

This chapter presents the research questions derived from the literature review and the identified research gap. These questions are consistent with the conceptual framework the author presented in chapter 2. The overall research question was a result of a call for empirical studies by Du et al. (2023) on how digital technologies influence innovative outcomes through virtual networks of MNEs. To explore the overall research question (RQ), it was broken down into three sub research questions.

Digital technologies allow MNEs to create global virtual networks and teams, coordinating global innovation without physical colocation, which reduces costs and enhances innovation (Du et al., 2023). Zeng et al. (2023) argued that virtual networks represent new hybrid market models, but do not replace traditional MNE governance. As a result, research should move beyond examining headquarters subsidiary relationships and instead focus on MNE strategic alliance partners and the roles of MNEs within virtual (digital) networks. Further, there is a need to understand multilevel studies that capture the MNEs control and coordination across different contexts, organisations, activities, and subsidiaries (Zeng et al., 2023). Therefore, RQ1 is

RQ1: How do MNEs develop and manage their virtual networks through digital technologies?

It is important for MNEs enhance their capabilities to harness digital technologies (Fleury et al., 2024) available to them and choose the appropriate systems to support their needs. According to Luo (2022b), a key aspect of digital architecture is how effectively an MNE integrate and leverage its digital technologies. In some instances, MNEs have excess of digital technologies which results in redundancy and incompatibility.

RQ2: How do MNEs enhance their capabilities to harness use of digital technologies in virtual networks?

Digital technologies transform how MNEs organise for value creation, delivery, and capture, with direct impact innovation outcomes in geographically dispersed network (Autio et al., 2021). Innovation outcomes refer to the ability to create innovations along the dimensions of products and services, production methods and processes, patents, management or marketing practices (Dahms et al., 2020; Du et al., 2023). Although significant progress has been made in digitalisation, more empirical research is needed to understand how virtual teams, virtual reality technologies, and wider digital infrastructures are transforming cross-border collaboration in R&D and innovation (Benito et al., 2022). In globally MNEs context, collaboration between geographically

distributed subsidiaries and their local networks is important to acquire knowledge and transform it into innovation outcomes (Dahms et al., 2025). Dahms et al. (2025) refers to MNEs internal and external networks, digital competencies, digital capabilities as important in driving for innovation outcomes, however, their study does not explicitly refer to virtual networks. Therefore, it is important to understand how the MNEs virtual network relationship equally drive for innovation outcomes.

RQ3: How do MNEs' virtual networks and digital technologies enhance innovation outcomes?

4. Research methodology

4.1. Research philosophy

This study followed an interpretivism philosophy with the objective of making sense of subjectively and socially constructed meanings (Saunders et al., 2023). The aim of this study was to explore how MNEs digital technologies enhance innovation outcomes through virtual networks for MNEs. The study captured contextual perspectives of participants which have been shaped by their experiences in the involvement managing inter/intra organisational virtual networks using digital technologies. All these perspectives of participants were subjective since they drew from their diverse backgrounds and experiences. In a similar way, the participant's realities were different, making their assumptions different but justified. Furthermore, the study appreciated the fact that the management of the inter/intra organisational networks, through digital technologies, to enhance innovation outcomes was dependent on the context of the business and was shaped by participant's own views.

4.2. Approach to theory development

The research followed an inductive exploratory approach to explore how digital technologies enhance innovation outcomes through virtual networks for MNEs. Inductive approach allows theory building from participants experiences, often reveals new constructs and(or) relationships that have not been conceptualised before (Corley et al., 2021). Furthermore, inductive studies start with a phenomenon, which in this case was the development and management of virtual teams, facilitated by using digital technologies. The methodology was ideal for this study since the conceptual work will be derived from participants insights and experiences of how they best use digital technologies to manage MNEs virtual technologies to enhance innovation outcomes.

4.3. Research methodological choice

This study was of a mono-qualitative nature because not all the constructs addressing the research question were formulated from the responses from the interviews. How MNEs develop and manage virtual teams to enhance innovation outcomes, using digital technologies was derived from the empirical data gathered. Qualitative methods are commonly used for understanding business and society issues in specific contexts, which specifically what this study aims to address (Crane et al., 2018).

4.4. Purpose of research design

This research was an exploratory, inductive, qualitative study since the study sought to explore and understand the different meanings that individuals or groups attach to phenomena (Saunders et al., 2023). This study followed a thematic analysis using semi-structured interviews. This study aimed to derive meanings on how MNEs develop and manage their virtual networks, using digital technologies, to enhance innovation outcomes, even to create a conceptual map thereof. The study aimed to derive new insight to refine body of knowledge about how digital technologies enhance innovation outcomes through virtual networks for MNEs or add empirical evidence to existing literature. These new insights or refinements add to existing body of knowledge in the international business and digital technologies domains. Exploratory studies are generally used to develop new instruments, generalise qualitative findings, test or develop a theory when the variables are unknown (Cuervo-Cazurra et al., 2016; Harrison, 2013).

4.5. Research strategy

This study was, using an interpretive phenomenological approach, through semi-structured interview. An interpretive phenomenological approach was “concerned with understanding and interpreting how human beings experience and make sense of the world” (Braun & Clarke, 2020, p 41). The phenomenon in play in this study was that of virtual networks for MNEs. Participants shared their experiences of how their organisations develop and manage their external/internal virtual networks, what capabilities are required to harness the use of digital technologies when managing these virtual networks, and lastly how these enhanced their innovation outcomes.

This study was conducted in South Africa, which represents emerging countries in the African context; extant literature on similar phenomenon has been studied in Europe and some parts of Asia (Dahms et al., 2020) and not explored in African contexts.

4.6. Time horizon

This research study was a ‘snapshot’ of a specific period, a cross-sectional study; it involved a specific phenomenon at a particular time (Saunders et al., 2023). The study aimed to collect rich insight on how MNEs develop and manage their virtual networks to enhance innovation outcomes, using digital technologies as an enabler. There were time constraints for conducting this study, hence the author has decided to use a cross-sectional study.

4.7. Target population

The population for this study was sample of MNE subsidiaries, operating in South Africa. The MNEs involved have South Africa as their host country or home country, however the participants were drawn from South African subsidiaries. The MNEs participating have internal/external virtual networks that they have developed and managed and were using digital technologies to facilitate activities. The target population included managers who interacted with internal and(or) external virtual networks and influenced innovation outcomes (innovations around product, process, services, or patents), for the MNEs. These included chief information officers, heads of data management, project managers, Innovation managers, digital transformation managers, R&D managers, marketing managers, supply chain managers, project managers.

4.8. Unit of analysis

The unit of analysis in this study was at the organisational level. The individuals, within the MNEs organisations, involved in the management of internal/external virtual networks for MNEs using digital technologies; the interaction of the individual with virtual networks must be towards enhancing innovation outcomes in the MNEs' subsidiary. The study aim was to for collect different experiences and knowledge of those individuals in MNEs organisations who developed and managed virtual networks to enhance innovation by using digital technologies. The study did not concentrate on any specific sectors or organizations; rather, it emphasized the knowledge and experiences of individuals within MNEs organizations that span various sectors.

4.9. Sampling method and size

The sampling method used in this study was non-probability sampling, homogeneous, purposive sampling because of the need to deduct themes from the information collected from the sample (Saunders). The following sampling frame was used

- *Type of organisation*
  The study used MNEs operating in South Africa, South Africa was either a hist country or a home country to the MNE.
- *Participants*
  The study targeted to interview those who were involved in developing and managing virtual networks which have direct impact on innovation like R&D managers, Innovation managers, unit managers, marketing managers, transformation managers, business architects.

- *Participants experience of the participants*

  The participants had experience in using digital technologies to develop and manage the virtual networks and were working in virtual teams. They were also expected to understand the use of the specific digital technologies they employed in their organisation. The participants were involved in some in some innovation activities within the MNEs

The sample was homogeneous since the target population had only the characteristics described above. The sample was from an emerging African country, South Africa in this context, and not sector specific.

The target was to conduct twelve to sixteen interviews for this study, (Saunders et al., 2023) , however due to time constraints the author was only able to conduct twelve interviews. Each interview took reported 35 to 60 interviews, which was sufficient for non-probability sampling for qualitative interviews. Data saturation is when additional data no longer generates new themes, codes, or categories for existing data (Saunders et al., 2023) . Data saturation was met by the tenth interview, since at this time there were less new theme arising.

The author grouped the different MNEs into clusters and these also were differentiated by colours; these were the automotive cluster, banking cluster, telecommunication cluster, and the manufacturing cluster. The participants names and names of their organisations have been coded to maintain confidentiality. The list of participants is ash shown in Table 2.

Table 2: Participant list

#	Participant ID	Participant sector	Company ID
1	A1	Automotive cluster	AM1
2	A2	Automotive cluster	AM2
3	B1	Banking cluster	BK1
4	B2	Banking Cluster	BK2
5	B3	Banking cluster	BK2
6	T1	Telecommunication cluster	TC1
7	T2	Telecommunication cluster	TC1
8	T3	Telecommunication cluster	TC1
9	M1	Manufacturing cluster	MN1
10	M2	Manufacturing cluster	MN2

11	M3	Manufacturing cluster	MN2
12	M4	Manufacturing cluster	MN3

4.10. Measurement instrument

The data collection instrument, semi-structured interviews, was developed from extant literature. An interview guide was created using insight from literature on development and management of virtual networks, digital technology use and capabilities, and impact of both constructs on innovation outcomes. The interview guide was divided into different sections with the aim of answering the research questions. The interview guide has been included in the annexure. The structure will be as shown in table 4.2

Table 3:Structure of content for interview guide contents

Section Topic	Literature	Research relevance
A: Set up the scene with participant		Understand the role of the participant
B: Virtual networks	Hung et al. (2021) Furr et al. (2022) Zeng et al. (2023)	Identify how participants develop and manage virtual networks. RQ1
C: Digital technologies	Dahms et al. (2025) Fleury et al. (2024) Teece (2025)	Identify digital technology capabilities. Identify best use of digital technologies. RQ2
D. Innovation outcomes	Dahms et al. (2020) Benito et al. (2022)	Identify if the intended outcome is achieved. RQ3
F: Reflection	Du et al. (2023)	Overall closing view. Answers overall research question.

4.11. Data collection techniques and procedures

Semi-structured interviews were used to explore how MNEs develop and managed virtual networks to enhance innovation outcomes by using digital technologies. Semi-structured, open-ended interviews may be used in exploratory studies and are useful in the inductive theory building approach (Saunders et al., 2023). Schmitt et al. (2025) supports the use of semi-structured interviews in exploratory studies since these enable the participants to express their views in their own ways to deliver comprehensive responses. The author held the interviews for thirty-five to sixty minutes with each participant.

The interviewer must keep the interview question open ended so that the interviewee may be able to express themselves more and divulge more learnings on the subject (Paschen & Ison, 2014). Miller et al. (2024) posits that interviews are the most used methods for qualitative research; however, these tend to be complex due to the accessibility of the potential interviewer.

4.12. Data gathering process

The data was gathered via semi-structured interviews; these were conducted using Microsoft Teams and the interviews were recorded and transcribed by using MS Teams., The interview recordings and transcripts were downloaded from Teams platform and saved in the author's laptop and google drive. An interview guide was be used to conduct the interviews; the questions were open ended to allow the participants the freedom to express themselves on the topics covered. The participants were be accessed through the author's professional network, thereafter, the interviewed participants invited connected the author with other potential participants from their networks. An initial email or Whatsapp message (request to participate) explaining the nature and intention of the study, was sent to the participants. A meeting date was set out and an invite sent. The consent form was discussed and signed by the participants before the interviews were conducted. The consent form clarified how confidentiality was maintained and the fact that the interviews will be recorded, even how the transcripts and interview data was storage accordingly.

The transcripts and interview recording data have been safely stored for 10 years electronically on the authors Google drive and computer for audit purposes; both require passwords for access.

4.13. Data Analysis approach

The data was analysed using Thematic analysis and the conceptual leap. The transcripts from the interviews were be coded, identifying themes and patterns to address the research questions. Furthermore, each transcript was analysed in full to pick up unique features of each participant's account. The frequency of mention of a theme did not highlight importance, but all the themes were given the same importance. According to Braun and Clarke (2020), an interpretive phenomenological approach has both thematic and idiographic orientation; this means that themes were identified across participants(case), and the focus was on the unique details of each participant.

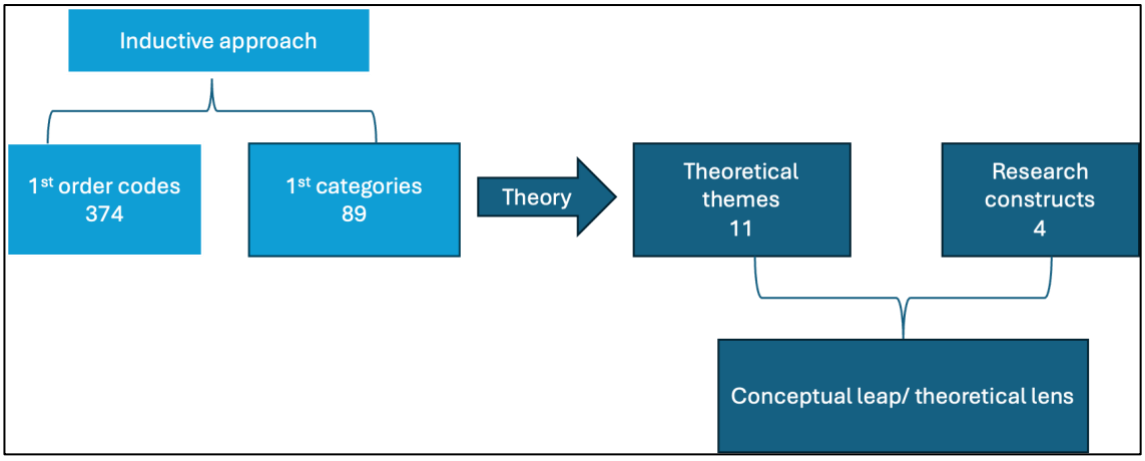
A coding software ATLAS.ti was be used to code for themes like collaboration, cultural intelligence, digital capabilities, etc.

4.13.1. Atlas.ti thematic analysis

The interview transcripts from MS Teams were downloaded and edited for grammar and loaded into Atlas.ti. 1st order codes were created from the interview transcripts, 374 code were created. An inductive approach was followed to develop 1st order codes, since inductive approaches are data driven (Braun & Clarke, 2021) . Further, the themes are topic summaries of overview of the thing the participants said in relation to the specific question (Braun & Clarke, 2021). Then codes were reduced to 1st order categories were created by merging the 1st order codes created, 89 1st order categories were created. These were created by merging the codes which had similar meanings.

4.13.2. Conceptual leap

Instead of completing the whole data analysis in an inductive way lens, the author followed a deductive approach (applying conceptual lens) to come up with theoretical themes; deductive methods are theory driven (Braun & Clarke, 2021). The theoretical themes were derived from the literature engaged, following a conceptual leap approach. A conceptual leap" generates abstract theoretical ideas from empirical data" (Klag & Langley, 2013, pp 149). Further, a conceptual leap is said to bridge the gap between empirical data and theory (Klag & Langley, 2013). From this, the theoretical themes were drawn based on the empirical evidence obtained. The empirical data matched nine theoretical themes that had already existed in literature and two additional new theoretical themes. These were linked to the four study constructs. This is shown in figure 2



*Fi*gure 2: Process of deriving themes

4.14. Quality and rigor

To validate credibility, the data was triangulated within the data sets from the interviews; comparing the data form the different clusters thus using multiple perspectives for mutual confirmation of data (Singh et al., 2021). Triangulation was done within each cluster participants, and across the different clusters. Four clusters have been identified, the automotive (A), banking (B), telecommunication (T), and manufacturing (M). Additionally, credibility can be built by ensuring that the findings are replicable by ensuring diversity in the empirical data collected (Cuervo-Cazurra et al., 2016).

To ensure transferability, purposive sampling was done; this is the use of participants that are representative of the phenomenon under study, being virtual networks in MNEs. Further, triangulation of the different contexts(sectors) broadens the applicability of the findings (Singh et al., 2021).

4.15. Ethical considerations

Miller et al. (2024) defined ethical research to be guided by ethical principles which include honesty, openness, objectivity, fairness, and accountability. This research was conducted in an ethical manner and caused no harm to any individuals involved; interviewees responded to questions on their own accord. An ethical clearance was completed and reviewed by the GIBS ethical committee before any data collection may commence. The names of the participants were not disclosed but coded to maintain confidentiality. Data protection was considered as per requirements by the GIBS ethical committee.

Considerations for GIBS ethical clearance application

Question 14.

To ensure confidentiality, no names of individuals or organisations were reported in the recordings nor in the report itself. The interview scripts were be coded as “Participant A1, B2 etc’ and saved as such instead of their real names. The participants were given a consent form to sign before conducting the interview and voluntary consent was explained to them. The participant had a right to withdraw from the interview, if they felt uncomfortable answering the questions. Organisations used pseudocodes reflecting their industries; for example, MN1 represents organisation 1 in manufacturing. In this way, the data was be kept confidential since anonymity cannot be guaranteed as the participant is known to the researcher. No details that could identify the participant or the organisation were be shared or requested as part were safely stored for 10 years

electronically on the authors Google drive and computer for audit purposes; both require passwords for access.

Question 15.

This study was conducted in more than one MNEs organisations and in the context of organisations, however, no specific or particular organisation is required as any organisation that meets the criteria in paragraph 9 would suffice. Therefore, no prior organisational consent is required.

4.16. Limitation of methodology

One of the limitations to this study is the time limitation hence the horizon used; this is because the author was given a specific time to complete their study. This cross-sectional time horizon does not allow for inclusion of changes in technology being used or the use thereof, especially with the rapid rate at which technology advances. A cross-sectional study assumes that the model parameters studied are stable over time (Bowen & Wiersema, 1999), however this study considers that moment in time and does not show appreciation of new developments in the relationship itself. Another limitation is that the author is a novice researcher, therefore quality of work may not be at a high level like an accomplished researcher.

The next chapter presents the research findings of the study.

5. Research Findings

This chapter covers the findings obtained from the data gathered from the interviews as described in the methodology chapter. The outcome of the thematic analysis described in 4.13 of Chapter 4 has been presented in the framework in Figure 3, which was adapted from Figure 1 in Chapter 2. The adaption includes two new themes as highlighted in the yellow writing. The conceptual framework is as shown in Figure 3

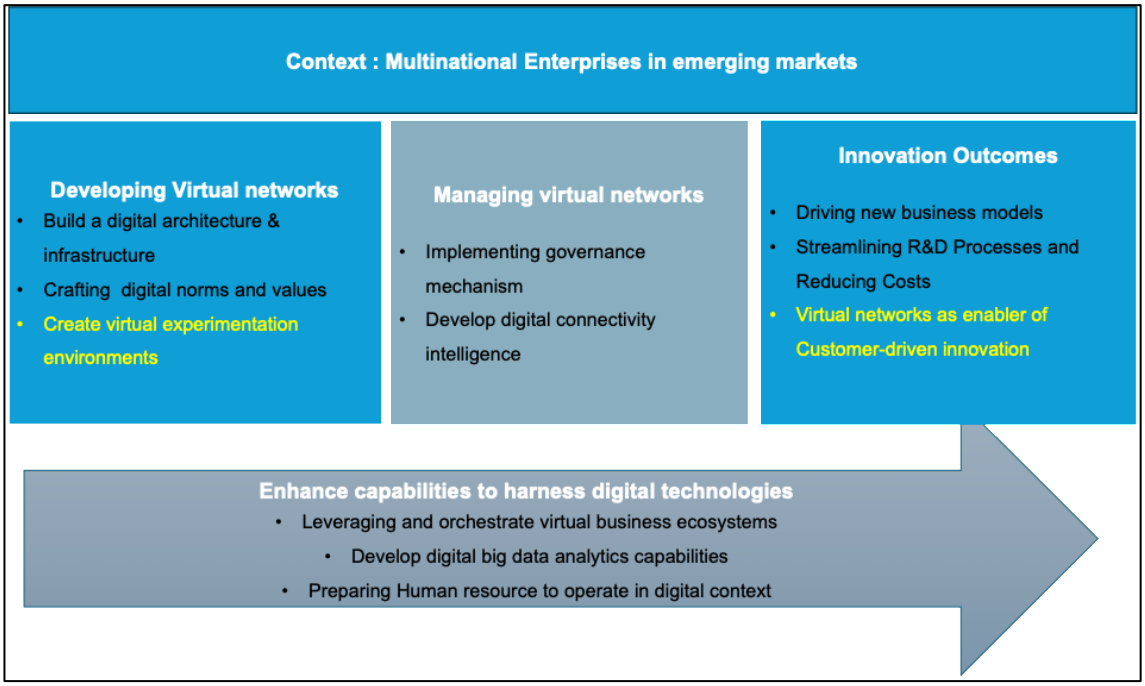


Figure 3: Updated conceptual framework (Author's own)

The findings revealed eleven themes which answer the overall research question 'how MNEs develop and manage virtual networks to harness digital technologies, thus achieving enhanced innovation outcomes. Two additional themes are 'create virtual experimentation environments' and 'customer driven digital transformation'.

This chapter will present all the eleven themes to answer the overall research question. The participants have been grouped into four industry clusters, namely: Automobile, Banking, Telecommunication, and Manufacturing. The participants from the automotive cluster are from the MNEs whose headquarters are in Europe and have subsidiaries South Africa. Participants from the Telecommunication and banking clusters are from MNEs with headquarters are in South Africa, with subsidiaries in the rest of Africa. Three of the participants from the manufacturing cluster have headquarters in Europe and one has headquarters in South Africa.

5.1. *RQ1: H*ow do MNEs develop and manage their virtual networks through digital technologies?

Looking at research sub-question 1, a heat map was produced based on all the first category codes under each theoretical theme identified. In an interpretive design of the study, the frequency of mention of the topic does not deem it more important than others. Colour coding was used to indicate the frequency of use of the codes within each cluster; light green indicating higher frequency, light yellow indication moderate, and light grey indicating low frequency. The heat map is as shown in Table 4.

Table 4 : Heat map showing themes for RQ1

Theme	Automobile	Banking	Telecommunication	Manufacturing
Build a digital architecture & infrastructure	Invest in Cloud-based platforms, Promote App development, Virtual collaborative networks	Invest in adaptive digital architecture, Invest in Cloud-based platforms, virtual collaborative networks	Invest in adaptive digital architecture, invest in Cloud-based platforms, Promote App development, virtual collaborative networks	Promote App development, virtual collaborative networks
Craft digital norms and values	allow employees to fail, provide employees psychological safety, camera comfort and use during virtual meetings, cultural intelligence	change management journey	camera comfort and use during virtual meetings, bet on people,	Allow employees to fail, provide employees with psychological safety, cultural intelligence, invest in change management journey,
Create virtual experimentation environment	Host virtual hackathons as participative innovation drives	Create Innovation labs, develop Innovation organisational mindset	Host virtual hackathons as participative innovation drives, Use virtual sandboxes as experiment safe spaces	
Implement governance mechanisms	Define clear roles and responsibilities, implement governance and security standards, Maintain Transparency	Digital agent deployment for network coordination, architectural compliance guides, Implementation of contractual digital relationships, Implement governance and security standards	Implement governance and security standards	Define clear roles and responsibilities, implement governance and security standards, Maintain Transparency
Develop digital connectivity intelligence	Develop a centralised intelligence integration, artificial intelligence & automation enablement, digital performance and reliability	Develop a centralised intelligence integration, federated networks, artificial intelligence & automation enablement, digital performance and reliability	Develop a centralised intelligence integration, federated networks, artificial intelligence & automation enablement, digital performance and reliability	Develop a centralised intelligence integration, artificial intelligence & automation enablement, digital performance and reliability

There are five themes responding to RQ1, since the aim of thisf research is to develop insight and understanding, and not a comprehensive review, the author has chosen not to discuss all five themes identified. Only three themes will be discussed in this section, as they illustrated key insight for the RQ1. The themes to be discussed for RQ1 are build a digital architecture and infrastructure, create a virtual experiment environment, and develop digital connectivity intelligence.

5.1.1. Theme 1: Build a digital architecture and infrastructure

Themes 1 to 5 answers how MNEs develop ritual networks, this evidence is part of the study construct “developing virtual networks”.

The following colours were assigned to the different groupings

Automobile	Banking	Telecommunication	Manufacturing

5.1.1.1. Evidence of building a digital architecture and infrastructure

5.1.1.2. Evidence of adaptive digital architecture

Table 5 :Evidence of invest in adaptive digital architecture

B3 “*I keep using the word modular architecture, we don't want that digital technology to be the next barrier for further innovation. It should be easy to remove, to grow, to scale and to deploy. “*
B2 “*You're doing encryption, you're doing segmentation, you apply zero trust principles, et cetera. Scalability. You'll be able to scale seamlessly based on business demands, performance, network uptime.”*
T1 *“from a design point of view, there's something we had to talk about often called modularity or composability. Composability of the design, meaning the designs needs to be building blocks that if I want to remove this partner, I just remove their piece. Now you are not evolving fast enough. We want to bring another player. We say that player we remove you like just a piece of Lego. We plug someone in; we are good to go. We are not tightly coupled to each other that when I remove you, you collapse the whole system. That for me, that is key.”*
T2 “*let's say that office grows from five people to 100 people. You should be able to put a technology that can scale while not wasting money. I mean the one of the powers of cloud computing is exactly that scalable elasticity, and you pay as you grow.”*

5.1.1.3. Evidence of cloud-based platforms

Table 6:Evidence of invest in cloud-based platforms

A2 “*there's layers of infrastructure that's in place we run a cloud infrastructure and already protocols that we inherit from places like AWS or Azure that would use, so that comes with its own security.”*
B3” *What we typically look at is using cloud networks versus on-premises networks where necessary. Virtual network would likely be the cloud networks that we're using, including certain third parties that we use to give us services that we typically can’t give ourselves. For example, architecture is very modular so if we need to plug in someone who does sales analytics in the US, it's easier to plug them, but they become a virtual network, they become an extension of us that looks like it's actually a product that is procured within us simply sitting on a separate cloud integrated through a virtual network into our DMZ or into our network into the into the organization”*
T3 “*These virtual networks like the Microsoft one or the AWS one, if they're used consistently across opcos within Africa, even globally, companies would definitely look at reduced operation costs because of it being standardized, and the interaction with other systems*

become predictable and they standardized. This would drive down costs with these virtual systems too, the amount of labour or skills needed to support it would also drastically decrease when you use a consistent a standard platform"

5.1.1.4. Evidence for promote App development

Table 7: Evidence of promote App development

A1 "*we're trying to build something like App Store. That's what we're trying to accomplish. A place where anyone from, anywhere could go but then internal, it's not for outside. Where anyone can go and look for an app that can track XYZ. I'm looking for an app that can do XYZ. The reason being given there are many offices at that many places, there's a duplication of applications."*
A1*" but when we have the App Store, it will be developed once and can be used by multiple people and then that's when the cost savings benefits can be seen."*
A2 "*I always think the maintenance of our applications versioning is critical to support these digital technologies that we have. If we're continuously innovating,"*
T3 "*If some applications built once in Egypt and it seems to be successful, we look at how we can introduce it to other countries without rebuilding from scratch because the code exists, we've got a API gateway where all these things can communicate via and then we're able to consume the same kind of services in South Africa."*
M2 "*There's a lot of apps that have been created lately because digitalization is quite important today in in the business. Those platforms, we have the capability to fit what we want the app to do, but generally we rely on start-up organisations to work on the development of the app*."
M4 *"We have a whole lot of internally developed applications, internally developed networks which are proprietary to us because there is nobody who really understands our business as much as we do. So those apps must be developed by our own people to suit the way that we work."*
M3" When *we start to establish or create apps for using the same information, product selection and so on. So, we're able to mutualize the experience of the globe and really packaging an app to allow people to be able to access the solutions."*

5.1.1.5. Evidence of virtual collaboration networks

Table 8: Evidence of virtual collaboration networks

A2 "*The virtual network is just basically a platform where various people can basically interact well, even if it's via video, chat or voice but in this network, you'll find that there's a lot of data that's exchanged and different types of data. These networks are always running all the time, and you'll find that it does help in terms of communicating, especially in people who are not necessarily within your area."*
A1 "We have set up ourselves in a way that we are able to do almost anything remotely except touch each other of course, those are the networks. On a day-to-day basis we are communicating with one another, collaborating with one another virtually."
B2 *"there the key is the collaboration enablement through these different virtual networks."*
B2 "So it's about creating this collaborative innovation type of a network using the virtual network and then inviting other suppliers, fintech's, invite them to come and share your solution. "
T2 "We've got technologies, digital virtual networks. How do I solve my customers' s problems? Think about it, if my customers are all in the same. In this case, in the same, they're all in mid-range, Do I really need expensive technologies to help them? Maybe not, but if they are everywhere, maybe I do need to invest a little bit more on the network."
T3 *"So, because of the platform that links us together, this virtual platform collaboration is fostered over time and learnings are easily shared and so that principle of a learning organization just gets accelerated to another level."*
M4 "*virtual networks are a system through which we collaborate at work, sometimes through meetings, sometimes through file sharing and storage, sometimes through common applications that we use"*

5.1.1.6. In-case analysis of evidence

Automobile(A)

Participant A2 refers to the cloud infrastructure and its security protocols that they inherit from the infrastructure itself. However, participant A1 does not mention anything about cloud infrastructures in their discussions. Both participants in the automobile cluster discuss applications, however, their perspectives are different. Participant A2 highlighted the maintenance of the application versions as a critical factor, while participant A1 focused on building a central app store. The reason for A2's view is that the app versions must support digital technologies for continuous innovation. According to Participant A1 building an App store allows apps to be developed once and reused multiple times, which eliminates duplication, thus realising cost savings.

Both participants highlight virtual networks to help with communication however A1 highlighted *day-to-day* collaboration and A2 highlighted the high level of data exchange (different type of data) in "*always running networks*". Both participants refer to time frames when discussing the use of virtual networks: A2 mentioned that the "networks run all the time," while A1 described "day-to-day" usage specifically for remote work setups. A2 stated communication for *"people who are not in the same area",* but A1 specifically outlined that their teams are setup for remote work hence the use of virtual networks. One more difference between the cluster perspectives on virtual networks is the fact that A2 specified the different modes of communication (i.e. even if it's via video, chat or voice) that could be used, but A1 highlighted that they "*can do almost anything remotely*" on the networks.

Banking (B)

Only participant B3 shared their experiences of adaptive digital architecture and cloud-based platforms in the banking group. Participant B3 highlighted the need for modular architecture so that architecture is not the barrier to further innovation. The participant B3 emphasises the need for the architecture to be easy to remove, grow, scale and deploy. Participant B3 talks about moving from on-premises networks to virtual networks which could be cloud networks or those from certain third parties. They also give an example of how separate cloud networks are integrated into an organisation's virtual network, especially with the modular architecture (plug. Only participant B2 shared their experience of virtual collaborative networks, they stated that collaboration enablement is key in different virtual networks. Furthermore, participant B2 shared that they form collaborative innovation kind of virtual networks in which they invite other suppliers to share solutions.

Telecommunication (T)

Only participant T1 and T2 shared their experiences adaptive digital architectures, and both have different focuses. Participant T1 highlighted the importance for modularity of composability of the design of the architecture, while T2 focused on scalability of technology, with reference to a growing organisation. Participant T1 explained how when one partner is can plugged or removed from the systems without it collapsing, using a *"Lego"* metaphor. T2 highlighted that one of the *"powers"* of cloud computing scalability, which allows organisations to pay-as-you-grow. Only Participant T3, in the automobile cluster shared their experience of how their organisations invest in cloud-based platforms. T3's view is that if organisations use virtual platforms consistently across their operating companies(opcos), they will reduce costs since these virtual systems are standardised. They further explained that when the systems are standardized, their interaction with other systems becomes predictable, thus reducing the skill required for support, and reduce costs.

When it comes to app development, participant T3 stated that if an app is successfully built in one country, their organisation looks at how it can be introduced to other countries without rebuilding from scratch. Participant T2 reflected on whether virtual networks help their organisation solve customer problems. In this reflection, participant T2 suggested that the investment in expensive technologies should be informed by the nature of customers, if their customers are *"everywhere"*, then there is a need to invest in networks. T3 has a different view from T2 on virtual collaborative networks. T3 saw the virtual platform collaboration to be accelerating "*the principle of a learning organisation*."

Manufacturing (M)

M2 and M4 have different experiences on how their organisations promote development of apps. M2 organisation relies on start-up organisations while M4's organisation develops apps internally. However, there seems to be similarities between these two participants in how their apps are developed. M2 referred to *"we have the capability to fit what we want the app to do"* while M4 refers to app being developed internally to "*suit the way that we work*." M3 brought a different perspective to the app development discussion, they highlight mutualising the global experience and packaging an app that will allow people to access their solutions. Only participant M4 shared experiences on virtual collaboration networks and highlighted the use of virtual networks for collaborating at work, file sharing and storage, and common apps they use.

5.1.1.7. Cross-case analysis

Only banking (B) and telecommunication (T) clusters shared their experiences of how their organisations invest in adaptive digital technologies. Both clusters' views are similar on the need for the architecture to be modular. However, there are differences: the banking (B) cluster explained the reason for modularity to be that the digital technologies must not be barrier for further innovation. The reason for modularity and composability from the telecommunication (T) cluster is so that when one partner is removed, the system does not collapse. The banking (B) cluster emphasized that digital technologies should be easy to remove, to grow, to scale, and to deploy, while the telecommunication (T) cluster focused on scalability and a "*pay as you grow"* approach. The banking (B) cluster highlights seamless scaling based on business performance, and network uptime, while the telecommunication (T) cluster referred to scaling as the organisation grows to avoid "*not wasting money."* Only the banking (B) cluster mentioned encryption, segmentation, and applying zero trust principles as far as the digital technologies and digital architecture is concerned.

Only manufacturing (M) cluster did not share their perspectives on how their organisations invest in cloud-based platforms. Both automotive (A) and telecommunication (T) clusters mentioned the use of cloud infrastructure like Azure, but automotive (A) referred to the protocols inherited as they come with own security. In contrast, telecommunication (T) referred to the use a standard cloud platform across all different operational companies(opcos), to "*drive down"* costs with virtual networks. Banking (B) cluster mentioned a different focus of the cloud architecture being modular, allowing to plug someone in another country, integrating their separate cloud through virtual networks into the organisation's network. The banking (B) cluster uses cloud networks which include third party service providers.

Only the banking (B) cluster did not share their perspectives of how their organisations develop apps. All the other clusters have different perspectives on app developments, and somehow some of the perspectives build onto others' ideas. The automotive (A) cluster mentioned building an app store to avoid duplication of apps and for central use. Telecommunication (T) cluster talked about building apps once and using in other countries without rebuilding. The manufacturing (M) cluster talked about building apps internally and externally and building the apps such that they suit how they work. Both automotive (A) and telecommunication (T) clusters share a similar vision for the app store, telecommunication (T) cluster may have not explicitly said but the idea is similar, they want to develop it once and deploy it in multiple countries, aiming to avoid duplication of effort. The manufacturing cluster (M) may share a different perspective,

mutualising global experience to develop apps with same information that provide users easy access to solutions. This perspective is similar to *"we look how we introduce apps in other countries*" as stated to "*mutualise"* global experience for building apps. Automotive (A) has a different insight, highlighting the need for app maintenance and versioning to continue innovating, since these support digital technologies.

All the clusters have shared their perspectives of how their organisations enable virtual collaborative networks; however, these groups focus on different aspects of virtual networks. The one similarity identified across all the clusters is that virtual networks are used for some form of collaboration. Some of the clusters mentioned the use of virtual networks internally (within the organisation), automobile (A) and manufacturing (M), while other clusters extended the use of virtual networks externally(banking (B) and Telecommunication (T). The banking cluster extended the virtual networks to their suppliers and fintech, and the telecommunication (T) cluster extended the virtual networks to customers. Each group has a different rationale for using virtual networks. For example, firstly, automotive (A) cluster uses virtual networks for daily communication and collaboration for remote work and for people who are not in the same area. Secondly, the banking (B) cluster uses virtual networks for innovative collaboration, where suppliers are invited to share your solution. Thirdly, the telecommunication (T) cluster uses virtual networks for their customers that are "*everywhere*" and accelerating a learning organisation. Lastly, the manufacturing cluster uses virtual networks for collaborations, meetings, file sharing and storage, and common apps. The one perspective that stands out is from the telecommunication (T) cluster where the investment in digital technologies is linked to their ability to enable the organisation to solve customer problems.

5.1.1.8. Conclusion of theme

All clusters have shared their views on how their organisations build digital architecture and infrastructure as part of developing their virtual networks. All their perspectives are shaped by the contexts of the organisational environments they operate in. The automobile (A), telecommunication (T), and manufacturing (M) clusters all shared different but complementary views about development of applications. The automobile cluster put emphasis on developing an app store to avoid duplication and ensuring the maintenance of the app versions. The telecommunication (T) cluster wants to build apps and deploy to other countries without building from scratch, while the manufacturing (M) cluster emphasised inhouse app building and external sourcing of apps that suit the way they do work. On the adaptive digital technologies, only banking (B) and telecommunication (T) clusters shared their experiences. Both have a similar view on

modular architecture, however their motivations for use are different. The banking (B) cluster highlighted that the digital technology must not be a barrier for future innovation, while the telecommunication (T) cluster focused on being able to remove a virtual partner without collapsing the system.

All four clusters acknowledge the importance of virtual collaboration networks, but the usage varies from internal to external networks. The automobile (A) and manufacturing (M) clusters use virtual networks internally, the banking (B) cluster extend the networks to suppliers, while the telecommunication (T) cluster extends to customers.

5.1.2. Theme 2: Crafting a digital culture and norms

5.1.2.1. Evidence of psychological safety

Table 9:Evidence of psychological safety

A2 "It's not about getting things right the first time, they need to fail fast because they'll come back hungry saying I know I can do this. I will come back and work until they get it right so allow them to fail. That will be my biggest recommendation, exposure and allow them to fail fast."
A1 "What would it look like to have a psychological safety for each person? You want to be heard; you want to be listened to and things like that, we can all agree to perhaps take a test in the beginning of what will be your language of appreciation."
M1 "For people to be comfortable to make decisions on their own, make mistakes and comfortably discuss those mistakes and deviations and set the way forward.

5.1.2.2. Evidence of cameras-on in virtual meetings

Table 10:Evidence of cameras-on in virtual meetings

A2 "Some guys who are shy, some guys who don't like cameras, for example. I love cameras a lot so the guys who switched off and I've noticed when a camera is off, the Germans, for example, love cameras on because they want to see you talk. You talk with your hand gestures. They like seeing that a lot so when you come off, I'm not sure what to say. I can hear your voice, but it's lost in translation."
A1 "We can say every time we have sessions; we will have our cameras on so that everyone can fully interact."
T2 "The camera can be very important because it brings the personality into the conversation. "

5.1.2.3. Evidence of cultural intelligence and adaptability

Table 11: Evidence of cultural intelligence and adaptability

A1" it's there like in the beginning, there'll be cultural differences, but over time, if the work is going well, those cultural differences quiet down."
A2 "I think the last one that's really challenging for me is it's not necessarily a virtual network issue; it's more of the different cultures. How one is like the Germans, for example, are very direct, could come off as intimidating, very rude. South Africa is a very friendly culture, if you don't know that there's a bit of a cultural thing , being in a virtual space won't necessarily eliminate that. You do need that occasionally travel to physically really read the room and the person to understand how they are and then come back on a call and you know, because a lot of the relationships are made online. "
M4 "If you talk about the human networks, obviously the biggest issue that humans have is cultural. It's usually the different cultures that you find when you move from one country to the next, when you move from one part of the same country to the other."

M3 *"When I say empathy, it's like, you know, sometimes when you grow up in one country, you tend to think that this is how things work. But when you're sitting with other people, you're able to realize that It's only set up in this way because of the prevailing conditions. So, there must be adaptations."*
A1 *"Diversity, like the diverse input that you get. The perspectives are different, the horizons are different so just being able to collect from different experiences, different perspectives, different backgrounds, you know that's what make it work. "*

5.1.2.4. Evidence of building trust

Table 12:Evidence of building trust

T2 *"Il think it's one of those things where you must bet on people, even if you don't, you haven't seen them in action."*
M3 *"I mean every relationship, whether it's virtual or it's physical, it's about building trust and if you want to build strong relationships, even if they're virtual, is basically to build a trust."*
M1 *"I think digital technology can have the best and not succeed. And it's about people. It's about people. It's about trust."*

5.1.2.5. Evidence of change management

Table 13: Evidence of change management

M3 *"change management. I mean this is the key because you're trying to take people who are used to working in one way. And you want now you want them to work in another way now."*
B3 *"agile and innovative than what we had previously meaning there has to be a people change journey, an architecture change journey, a technology change journey, a hosting change journey, and then there has to be a way of work DevOps"*

5.1.2.6. In case analysis of evidence

Automotive (A)

Both participant A1 and A2 shared different views on psychological safety. A1 focused on psychological safety in terms of "*language of appreciation*", while A2 focused on allowing people to "*fail fast"*. Both participances of the automotive (A) cluster shared similar views on the camera use during virtual meetings. Participant A2 further, elaborated that some people want to see others faces and gesture when online, for your voice not to be lost in translation. Both participants in this cluster shared their views on how cultural differences play a role in online teams. Participant A1 explained that the cultural tension is at the beginning of the virtual team formation and eases away as the team members get to know each other. Participant A2, on the other hand, highlighted the need to have both virtual and physical teams; they suggested travelling to the different counties to understand people better, since online presence does not get rid of the culture "*thing".* Participant A1 also highlighted how diverse inputs make virtual team setups *"work*", collecting diverse perspectives, horizons, experiences, background. Participant A1 also share the need for psychological safety within a virtual team.

Banking (B)

Participants in the banking (B) cluster did not share many experiences on how their organisations craft digital norms; only participant B3 highlighted the need for change in the way the DevOps work since people, architecture, technology, and hosting will change.

Telecommunication (T)

Participants T1 and T2 shared their views on the crafting of digital norms; both participants have different views. Participant T1 highlighted the use of the camera brings personality in virtual set ups, while T2 mentioned “betting” on people even if you have not seen them in action.

Manufacturing (M)

The perspectives shared by the manufacturing (M) cluster are different. M1 shared their experiences regarding how their organisation enables employees to feel comfortable making decisions, learning from mistakes, discussing mistakes comfortably, and set a way forward. Participant M4 shared their views on cultural differences impact human network’s. M1 and M3 share similar view on building trust with people within o virtual or physical relationships.M3 emphasised that adaptation and empathy are important as one needs to realise that things are not the way you have been exposed to them. Additionally, M3 shared the need to get through change management since the employees are used to a way of working.

5.1.2.7. Cross case analysis

Across the clusters, the automotive (A) and manufacturing (M) have emphasised similar views on psychological safety, where employees can make decisions, fail, and discuss the failure comfortably. The automotive (A) have extended that the virtual employees’ languages of appreciation must be known. Only automotive (A) and manufacturing (M) clusters shared their experiences of cultural intelligence. The two clusters acknowledge the difference in country culture. The differences in the view are where automotive (A) cluster highlighted the need to travel to other countries to understand them better, and the manufacturing (M) highlighted empathy for prevailing conditions, and adaptability. Further, the automotive (T) cluster emphasised what diverse inputs, interpretations, backgrounds, horizons, and perspectives make the virtual networks work.

Both the automotive (A) and telecommunication clusters had similar views on camera use during virtual meetings. The automotive cluster highlighted how others value seeing hand gestures and facial expressions, while the telecommunication group emphasised

that cameras lend a personal touch to interactions. The manufacturing and telecommunication clusters had similar views about building trust within the virtual networks. Both the clusters emphasised on “people”; the manufacturing (M) clustered highlighted that even if you have the best technologies, it’s all about people, while the telecommunication (T) emphasised betting on people. The manufacturing (M) and banking (B) clusters both highlight the importance of change management involving people, architecture, and technology. Manufacturing (M) focused on shifting the way of working, while banking emphasised agility and innovation as drivers of change.

5.1.2.4. Conclusion of theme

Participants consistently emphasize that technology acts as an enabler, but successful collaboration relies on trust, empathy, psychological safety, and cultural intelligence. The findings reveal that psychological safety and a learning-oriented culture which allows employees to make decisions, fail, and adapt, and talk about their mistakes comfortably. Country cultural intelligence was highlighted for better understanding others’ perspectives, have empathy, and to adapt. The automotive (A) cluster further elaborated that to gain this understanding, it is important to travel to the countries. The telecommunication (T) cluster highlighted the importance of diversity in terms of inputs, interpretations, backgrounds, horizons, and perspectives, as a success factor for virtual networks. Moreover, cultural intelligence and virtual presence are essential in bridging communication gaps and ensuring inclusion across diverse geographies. Practices such as keeping cameras on, promoting active participation, and recognising cultural nuances enhance interpersonal connection, trust, and reduces the tendency for the communication to be lost in translation during virtual interactions. The manufacturing (M) and telecommunication (T) clusters both highlighted that even of an organisation has the best digital technologies, people are very important. Change management involving people, architecture, and technologies was highlighted as important, the manufacturing (M) cluster focused on shifting the way of working, while the banking cluster focused on agility and innovation as drivers of change.

5.1.3. Theme 3: Create virtual experimentation environment

5.1.3.1. Evidence of creating a virtual experimentation environment

Table 14: Evidence for evidence of creating a virtual experimentation environment

A2 *“there are points where we have these hackathons, where a guy who was in after-sales found something upstream where a car is developed. A product was developed in some feature in a car, where they took that feature and they used it within the IT space, which is not necessarily a vehicle, for example. If we didn't expose them to what we had initially, we would never have gotten that. He would have just been a computer person, but now because we*

exposed them, now they've brought that innovative idea, showed us, and in fact, just to get a little bit deeper in that one, that initiative drove one of our digital initiatives or technology. "
T3" A *hackathon is like an innovation event. People, they come together as teams, and they're given some problem. In my organization they might say, listen, we got a problem here. We're overspending so much when we deploy the following software in market ABC, can you maybe they bring teams together and they say solve the problem and then see teams think together but it's all done using technology. It's a collaborative innovation kind of hub so we use hackathons to solve some of the problems."*
B2 *"it's about how do you create a cohesive space, and I call it the innovation labs. I always had this idea of how do I create a lab? You know when they put the colours together, if you put two colours together, it changes to one colour, how do you create that space for people to come up with ideas and not ideas for today, ideas for future fit, right?"*
B3 "*They must also change the organisational mindset to be that of innovation, the way of living, the way of thinking, the way of conversation, the way of decisions, the way of strategy and strategy building and strategy measurement in that organization must be for in digital innovation."*
T3 *"I think the success in innovation; it can bring people together very easily. It can create, for example, virtual sandboxes, environments where people can experiment. You know a sandbox is an environment, a protected environment where you know you talk about a regulatory sandbox for example. They relax the rules and people can fiddle around and play so even on the digital side you can have a virtual sandbox; you can have people in India collaborating with us here in South Africa in this virtual safe space. It's just a fertile ground for innovation to happen, you're able to bring brains and thinking together across borders instantaneously."*

5.1.3.2. In-case analysis of evidence

Automobile(A)

Only participant A2 shared their perspectives of how their organisations create virtual experimental environment. Participant A2 highlighted the use of hackathons as driver for digital technology initiatives. The participant shared an example of how these hackathons enabled an after-sales employee to come up with an innovative idea that was not related to their work; this idea resulted as the driver for one of their digital initiatives. Additionally, A2 emphasised that innovation happens when there is exposure to different environments, i.e. the employee from after-sales has proposed an innovative IT solution.

Banking (B)

Participants B2 and B3 shared their perspectives on how their organisations create virtual experimental environments. The views of the two participants are different since B2 suggested a practical example for creating these virtual experimental environments, while B3 focuses on an innovative organisational mindset. B2 suggested creating a cohesive space for people to come up with ideas for the future, an innovation lab. B2 emphasised the need for an organisation to chang mindset to an innovation mindset; this is where the strategy measurement must be for digital innovation.

Telecommunication (T)

Only participant T3, in the telecommunication (T) cluster, shared their perspectives on how their organisation creates virtual experimental environments. Participant T3 highlighted the use of innovation events like a hackathon to get people to solve problems using digital technology. A hackathon is a collaborative innovation hub that is used to solve some of the organisations' problems. Additionally, Participant T3 suggested the use of virtual sandboxes where people can experiment in a protected environment. The participant emphasised these virtual sandboxes are fertile ground for innovation, in that they can "*bring brains and thing together across borders."*

Manufacturing (M)

There were no views shared by this cluster on creating virtual experimental environments. The participants in the manufacturing (M) cluster are manufacturing operational personnel and mostly are end users in most of the digital interventions in their organisations. In their roles, innovation happens in the traditional, physical manner.

5.1.3.3. Cross-case analysis

The manufacturing (M) cluster is the only cluster that did not share their perspectives on how their organisations create virtual experimental environments. The participants in the manufacturing (M) cluster are manufacturing operational personnel and mostly are end users in most of the digital interventions in their organisations. In their roles, innovation happens in the traditional, physical manner.

Automotive (A), banking (B), and telecommunication (T) clusters all have similar views since they are all describing innovation environments or spaces where employees are allowed to experiment with innovation as an outcome. All these spaces take place because of digital technologies; automotive (A) cluster referred to digital technologies, banking (B) cluster referred to a '*space*', while telecommunication (T) referred to "*virtual safe spaces."* The difference is that the banking cluster(B) also mentioned changing the organisational mindset to an innovative one, where innovation is a "*way of life",* others did not specifically mention anything in line with this. These three clusters bring different perspectives in what they view to enable their innovation. For example, automotive cluster mentions exposure to different environments, banking (B) cluster mentions innovation organisational mindset and ideas for the future, and, lastly, telecommunication (T) mentions cross border innovations and innovative collaboration to solve problems. Automotive (A) and telecommunication (T) clusters both mentioned hackathons as drivers of innovation. However, the difference in their views is automotive (A) cluster described hackathons with a real-life example and emphasised the need for employee

exposure, while the telecommunication (T) explained that hackathons are used for problem-solving sometimes.

5.1.3.4. Conclusion of theme

Across the three clusters innovation is viewed as a collaborative process that may be enabled by environments which allow employees to be creative and experiment. The experimental digital environments identified in the evidence are hackathons, virtual sandboxes, and innovation labs. These were identified by the automotive (A), banking (B), and telecommunication (T) clusters. Their focus and execution of these experimental digital environments vary according to their organisational contexts. Automotive (A) cluster focused on cross-functional employee exposure, the banking (B) cluster focused on innovation mindset and ideas for the future, while the telecommunication (T) cluster focused on collective, cross border problem solving. In contrast, the manufacturing (M) cluster made no contribution to the topic of innovation experiments. This may suggest that these participants use traditional approaches to innovation and not digital or virtual innovations.

5.1.4. Theme 4: Implement governance mechanism

5.1.4.1. Evidence of implement governance mechanism

Table 15: Evidence of implement governance mechanism

A1"setting up what you call a project charter or a team charter where you establish what will be your rules of engagement when embarking on this task or on this initiative"
A2 "So our organization does it both ways. We do have our own internal main network we deal privacy aspect where we must protect our data. So, we have our own internal Virtual networks that we communicate with, obviously using a VPN, which is a virtual private network that we basically ensure that from a security point of view that this type of network is only within our organization. It's quite a tedious process to log on to the network and to exchange information."
B2 "There's compliance and standards that whichever supplier need to adhere to work with us towards a common goal."
B2 "There are things like cyber-attacks, data, all of that and you don't want those things to get into your network because then you face bigger problems at the end of the day."
B2 "there's very specific rules, regulations, frameworks we must follow."
B3 "The governance part is whether we're creating and using this data in line with the regulations of every country that we create this data in, when we move this data and exchange this data for strategy or anything, whether we're doing this across the rest of the jurisdictions across the borders in effect correctly in line with the jurisdictional laws and data sharing laws and privacy laws across those countries or jurisdictions and then effectively running the analytics and data science function of it producing the with this data."
B3 "First the organization is called jurisdictional policies. There are the group policies which we call level 1 policies that cover the rest of the groups and then there's level 2 policies which are the different clusters that exist in the organization, irrespective of which country, then third is country specific policies and standards that enable the level 2 policy and the level one policy. We've got what we call policy, regulatory and architecture guilds and compliance guilds that actually checks that this compliance requirements are met irrespective as part of the product

approval process and when that is done then innovation can go in earnest but effectively, we are ensuring that the requirements of the country, cluster and organization are met."
T1 "There is more about structured governance. We need governance in place and then it needs to be platform-based integrations and securely so and we'll have shared KPI's securely."
T1 "I think security as well, because ecosystems, span into the customer environment, you don't want to expose or compromise customer environment as far you need that governance in place. You need to make sure that the security frameworks, we all adopt cyber security frameworks and from all our designs we need to make sure that security is embedded at each and every layer of the design"

5.1.4.2. In case analysis

Automotive (A)

Both participants in the automotive shared their experiences on how their organisations implement governance mechanisms; they are both sharing different ways in which their respective organisations put governance in place. Participant A1 highlights the use of a project charter, while participant A2 emphasised the use of VPN (virtual private network) at system level.

Banking (B)

Only B2 and B3 have shared their experiences on how their organisations implement governance mechanisms. Both participants highlight the need for regulations to be followed. B2 emphasises compliance to standards, specific rules, regulations, and frameworks to avoid cyber-attacks, while B3 emphasised on multi-layered compliance structures that ensure cross border legality when using data and analytics. B2 further emphasised the use of jurisdictional laws, data sharing and privacy laws, that are used in their organisation. Further, B2 noted the use of regulatory and architecture guilds and compliance guilds that checks that this compliance requirements are met.

Telecommunication (T)

Only T1 shared their experience of how their organisations implement governance mechanisms for virtual networks and digital technology use. T1 emphasised the need for structured governance, platform-based integration and shared KPIs. T1 noted they adopt cyber security used of security embedded digital platforms to avoid compromising their customer environments.

Manufacturing (M)

No experiences on implementation of governance mechanisms were shared by the manufacturing cluster.

5.1.4.3. Cross case analysis

A1 highlighted procedural governance through project charters, B3 and T1 referred to formalised governance structures at an organisational and technological level. B3 refers to policy layers at country level reflecting regulatory governance while T1 refers to platform -based structured governance, embedding security into digital architecture. A2 focused on operational security via VPN use to ensure internal data privacy. Both B2 and T1 highlighted cybersecurity, however B2 emphasised adherence to compliance and standards to avoid cyber-attacks, while T1 emphasises that the security must be embedded by design into the digital ecosystems. B2 and B3 experiences are more in line with organisational compliance governance while A1 and A2 are more operational and procedural governance based on internal management systems.

5.1.4.4. Conclusion of theme

The findings on implementation of governance mechanism are concerned with organisational compliance or operational, procedural governance. The different clustered have shared different views on how digital governance is employed in their organisations. The automative(A) cluster referred to the use of project charters and VPN for ensuring security. The banking (B) cluster referred to compliance to rules, standards, regulations, and cross border security structures. Both the automotive (A) and telecommunication (T) clusters noted cyber-attacks but device different ways of protecting the organisation against these. While B2 avoids cyber-attacks by adherence to compliance and standards, T1 referred to the security being embedded by design into the digital ecosystems.

5.1.5. Theme 5: Develop digital connectivity intelligence

5.1.5.1. Evidence of develop a centralised intelligence integration

Table 16 : Evidence of develop centralised intelligence integration

A2 *"They are linked to all these different hubs or that I spoke about in terms of innovation and what they do, they continuously inform them. You find that there's a head of innovation, all these departments that this researcher just continuously feeding them, but they as well also feed the research centers of data and in this thing we're able to get this information. It translates that to all of us wherever we are, especially on the tech side and we see what's today."*
B3 "*the way that we architect should be creating a product. It must go through a product approval process that makes sure that it meets all the architectural requirements. But, it also allows for innovation to be shared to center, unless it's well specialized just for the area, but it will be visible to center as well. That's the way that we manage in those virtual networks. "*
B2 *"today we've migrated most of our on premium network capabilities to cloud-based capabilities, right. So, in cloud based you can go, there's different things, there's data lakes, there is AWS, all of that. So, we've rewired basically this network stack and promoted that into a cloud-based application. And from there we derive analytics, we derive data, we check our performance of our different integrated networks, which we call APIs, right, that supports our different platforms."*

T2 *"I'm going to probably think of what we call one up, we've kind of launched it in many countries anyway. The idea there is we build once and then we scale to add to other countries so using API hub, we're able to expose certain APIs from a central API hub up to certain markets and that would not be possible if we didn't have virtual market virtual networks because there's a security is very important."*
T1 "*We always have this saying where we say these platforms needs to be secure by design, meaning security is embedded on these platforms so that when we onboard partners for us to have to build that ecosystem, we onboard them securely using standard practice, standard protocols that are open industry standards but securely so that we don't expose the environment and end up exposing customer data."*
M2 *"So the global R&D is based in France. And then we also have another similar based in Italy. So, we have two main centres where core innovation is done so it then there is a platform that has been created called ITMS. So ITMS is International Transfer Managers, so with International Transfer Managers. Information coming from the regions."*
M1 *"Conducting meetings, progress, sharing ideas happens on Teams, but then for particular projects, once they move on to ideation phase, especially when we develop the project cross regionally, meaning South African R&D, European R&D or even North African R&D. We've got a digital platform called Accolade. It's basically you can look at it like a Stage gating project management tool where you need to address various aspects of the project from ideation to scale up. So because we are a manufacturing company, the pillars that will be have to be addressed, they involved your manufacturing, your technical, your laboratory developments, business case."*
M4 *"We have a technology hub in India. We have a technology hub in Nigeria. These technology hubs, they sort of serve different purposes. Our technology hub in India, for example is very suited towards maintenance of existing systems. If something goes down in any part of the world, the technology hub in India would be able to remote dial in, check what the system is. They can try to solve the problem. If they can't, then they need to call somebody that's on site there and maybe guide them through how to solve it. The technology hub that we've got in Nigeria, that's our creative technology hub. They are the ones writing new apps, they're the one creating new programs that they want."*

5.1.5.2. Evidence of federated networks

Table 17: Evidence of federated networks

B3 "*Typically, each cluster is able to spin up its own virtual network that is specialized for their own function but effectively matched back into the top architecture based on what we call data domains or information domains. They create data or information and a process on innovation within their Federated networks. They must publish up, then we all publish into center for use across the rest of the organization."*
T2 *"You can start slicing your network depending on what you want to do and then from a management point of view, you also wanted so that you don't have one single point of failure. You kind of want to have this federated kind of approach to say you've got your centralized controller, but you've got other controllers that are helping to keep it spread across regions because of those things."*

5.1.5.3. Evidence of digital performance and reliability

Table 18 : Evidence of digital performance and reliability

A2 *"How do you access data so the whole security as much as the response part of the infrastructure is a key component that supports such technologies."*
A2 *" We get an answer quickly and I love the fact that it enables us to fail quickly even where something didn't necessarily go right"*
B3 *"virtual networks allow you to integrate quickly, to innovate quickly, to digitize quickly, to have access of information and sharing of information much quicker and it also allows you to go through the barriers of creation."*
B2*" I made the comment about people working in India. I mean global connectivity is there. You are not limited now. It's an unlimited access to many resources."*

T1 *" We've got a platform where I'm sharing the designs, say guys, this is what I'm working on. It could even be now we go get into meetings. We have shared folders where they can see this thing in real time as there are changes, they are seeing the changes so that when now this deal is signed and say guys we need to integrate."*
M2 *"the time of or speed to market because when you have access to information and it's easy to follow, you can then have a better understanding of performance, and you can then implement, develop, or you can launch much quicker. You can launch products much quicker.*
M3 *"one is accessibility. Some of these platforms are not always easily accessible outside areas that are not connected. So, if you really want to leverage this element of, you need to make sure that whatever you build, whatever that they're accessible and easily."*

5.1.5.4. In case analysis of evidence

Automotives(A)

Only participant A2 shared their experiences on how their organisations develop digital connectivity intelligence as part of how they manage their virtual networks. Participant A2 highlighted that they have different hubs and research centres through which information and data flows. These hubs or research centres are the connection between all the departments as they translate to all the employees "*wherever they are"*. The feedback from participant A2 about artificial intelligence and automation was that they are moving their meetings to augmented reality, making meetings more personal. Participant A2 highlighted the importance of security when accessing data; security should support digital technologies. This participant further highlighted that virtual networks allow them to get quicker answers and allow them to "*fail quick*".

Banking (B)

Only participant B1 did not share their views on how their organisations develop centralised intelligence integration. Participant B3 discussed the product approval process for architectural requirements, while Participant B2 discusses their migration to cloud-based applications and how these are supported by different integrated networks, APIs. Only participant B3 provided insights regarding the methods by which their organisations generate data or information and manage processes within their federated networks. These networks enable each cluster to "*spin up*" its own virtual network specialised to own functions, while maintaining connectivity to the centre domain. Only B3 shared their views on the use of artificial intelligence and automation, demonstrating that cloud first, virtual networks, artificial intelligence, and machine learning are deeply integrated into their business operations. They deploy or use AI capabilities to anticipate trade or do market intelligence research without human being involvement. These robotic agents collect unstructured data and convert it into machine readable analytics.

B2 and B3 present complementary perspectives on the how virtual networks enhance of digital performance and reliability. B3 highlighted "*quick*" integration, innovation,

digitisation, and improved access to and sharing of information, while B2 focused on global connectivity and the access to unlimited resources.

Telecommunication (T)

Only T3 did not share their experience of how their organisations integrates or centralised their digital intelligence. Both participants , T1 and T2, have views about security but one spoke about central APIs while the other spoke about secure platforms. T2 highlighted that through a central API hub , their organisation was able to securely expose or extend APIs from one country to another. They achieve this through what they call “one up” which follows build once and scale concept. Participant T3 shared a different view about security by mentioning that the platforms they use are secure by design, where security is embedded on the platforms. This ensures partners are onboarded securely, using open industry standards, and not exposing customer data.

Only T2 shared their views about federated networks, where they highlighted that there should be a centralised controller for the networks, having other controllers keep the network spread across regions. This is also to avoid having a single point of failure. Only T1 discussed the use of artificial intelligence and automation in this cluster. Their view was that due a lot of data generated from the platforms, AI can be embedded to mine the data for insights that inform services and products created. Theses insights may also be used to make new products or generate new revenue streams. Only T1 shared their perspectives on digital performance and reliability, which is about real-time information sharing ,during meetings or when they are working on designs.

Manufacturing (M)

Only participant M3 did not share their experience of how their organisation centralises or integrates digital intelligence. All the other three participants share similar views in terms of their organisations having R&D centres in different countries or regions across the globe and using specific digital tools or platforms to facilitate projects. M1 spoke about Accolade and M2 spoke about ITMS. M4 spoke about technology hubs, one in India for maintenance of existing systems, and the other in Nigeria, for innovation. M1 and M2 perspectives are different in that M2 mentioned two main global R&D centres which are responsible for innovation, with input from region, while M1 implies cross-regional project management.

Participant M4 highlighted "*deploying innovative systems"* that can capture their machine data, enabling brewing mangers to download their production reports at a *"click*". In terms of digital performance and reliability, only M2 and M3 shared their experiences. Their views are different, M2 mentioned speed to market, access to information, launch quicker with the use of digital technologies. M3 highlighted the importance of accessibility for areas that are not connected.

5.1.5.5. Cross case analysis of evidence

All the clusters shared their experiences of how their organisations integrate or centralise digital intelligence. Both banking (B) and telecommunication (T) clusters mentioned the use of APIs but with different perspectives. The banking (B) cluster referred to APIs supporting the cloud-based applications, while telecommunication (T) cluster spoke about central API hubs that are securely exposing or extending APIs from one country to another. Both these clusters are concerned about platform security, but the banking (B) cluster extended on the security idea and emphasised the approval process for architectural requirements. The automotive (A) and manufacturing (M) clusters share similar experiences with the research centres, R&D centres, or technology hubs through which information flows. These are similar even though the application differs from context. All clusters except the automotive (A) cluster mentioned the use of platforms, banking (B) cluster mentioned cloud-based platforms, telecommunication (T) mentioned secured by design platforms, while the manufacturing (M) cluster mentioned ITMS, Accolade, and Teams.

Only the banking (B) and telecommunication (T) clusters highlighted the use of federated networks, where multiple controllers operate under a central architecture. The views of these two clusters are also similar when talking about how the virtual network is "*sliced"* or "*spin up"*, the banking (B) cluster mentioned that each virtual network is specialised in their own function, while the telecommunication (T) cluster referred to "*depending on what you want to do*. "*Depending on what you want to do* "may be regarded as functional.

All the clusters shared their experiences of how their organisations enable artificial intelligence and automation through virtual networks. The views across all the clusters are different in this case. Automotive (A) cluster mentioned the use of augmented reality in virtual meetings to make meetings more personal. The banking (B) spoke about AI, machine learning, and deployment of robotic agents for different functions, for example AI for anticipating trade, and robotic agents doing market intelligence research. The Telecommunication (T) cluster mentioned embedding AI into platforms for data mining to

create insights the inform services and platforms. Lastly, the manufacturing (M) cluster spoke about automated data capturing for their production reports. The banking (B) and telecommunication (T) clusters have similar views about the use of AI in mining unstructured data and turning it into useful insights.

All the clusters shared their experiences on how virtual networks impact digital performance and reliability. The automotive (A), banking (B), and manufacturing (M) clusters referred to how they can do things quickly. Banking (B) and manufacturing referred to accessing and sharing information quickly or easily, even though the banking (B) cluster extended the list with quick integration, quick digitization, and allows you to go "*through barrier of creation"*. All the clusters have something different in their experiences, for example automotive (A) highlighted access data securely, banking (B) highlighted global connectivity, telecommunication (T) highlighted real time sharing, and the manufacturing (M) cluster highlighted accessibility to areas without connection. What stood out is the concept of *"failing quickly*" from the automotive cluster.

5.1.5.6. Conclusion of theme

The evidence presented in under the theme of developing digital connectivity intelligence in answering RQ1 on how MNEs manage virtual networks. There are similarities and differences in the perspectives presented by the different participants in different clusters. These differences exist because of the nature of the business environments that the organisations find themselves in. The automotive (A) and manufacturing (M) clusters operate in a similar way that both have research centres or hubs across the globe; these research centres are responsible for the coordination of data flows from the subsidiaries and for sharing. The telecommunication (T) and banking (B) sectors are more concerned about API integration from the central API hub or from one network to another. All clusters use some sort of digital platform or tools, and the telecommunication (T) cluster emphasised the need for a secure by design platforms.

The use of AI and automation is present in different ways among the clusters; these are used based on the industry. The banking (B) cluster seems more advanced in their use of AI and other digital technologies for data mining, i.e. this cluster highted the use of AI, machine learning, and robotic agent deployment. Most clusters highlighted how quickly they get things done with virtual networks. What stood out in this regard is the automotive (A) sector is virtual networks allowing them to "*fail quickly*." One of the other different perspectives was from the manufacturing (M) cluster about easy access outside areas that are not connected; digital technologies or tools require internet connection.

5.2. RQ 2: How do MNEs enhance capabilities to harness digital technologies when managing virtual networks?

In this section, the evidence for sub-research question 2 will be presented. RQ2 looks at how MNEs enhance their capabilities to harness digital technologies when managing virtual networks. A heat map showing the frequencies of the mention of the different 1st order categories has been illustrated using colour coding, namely green for high mention, yellow for moderate mention, and grey for low or no mention. Not all the 1st order categories in the heat map will be discussed; only key topics will be considered.

Table 19: Heat map for RQ2

Theme	Automobile	Banking	Telecommunication	Manufacturing
Leverage & orchestrate virtual business ecosystems	Collaborative solution design	Collaborative solution design, innovation ecosystem readiness,	Co-creation, Partner integration, External Capability & skills sourcing, Digital capability development, Leverage subject matter expertise, new partner onboarding, share wallet, building network across organisational boundaries	
Develop digital big data analytics capabilities	Big Data Strategy Formulation, enhance Data Analytics capabilities	Building Artificial Intelligence capabilities, Big Data Strategy Formulation, Drones used for data collection		Big Data Strategy Formulation, enhance Data Analytics capabilities
Prepare human resources to operate in a digital context	Dual-Tier Talent Strategies, high tech skills, continuous upskilling of employees	Skill scarcity, hiring abroad, partner for skills, training of digital agents	Dual-tier talent strategy, training programs, digital recruitment drive, upskilling, bring partners, use of automation	Use of uniform templates, training programs, network training

5.2.1. Theme 1: Leverage and orchestrate virtual business ecosystems

5.2.1.1. Evidence of collaborative solution design

Table 20: Evidence of collaborative solution design

A2 *"The prototype is also sitting in these three markets the other two markets as well as in South Africa. Whatever we do here, we need to somehow connect in this virtual network and almost mimic it that side. As much as this part does a certain thing with this prototype, we have to almost mimic it to the other markets and they must confirm that it's doing and not breaking their line because we're not always in sync. I think every two weeks we do sync because we work in sprints, but when you're working quite in isolation, but in terms of the software you're working your code and when you test, you need to ensure you test before the two weeks has passed"* 3:29 ¶ 7 in Research Interview _ Goba A 2.docx
B2 "there's maybe 50 other people working with me and they might be scattered. There are people that we have today that's sitting in India, but they're working for me. That's why I have the circle where we can collaborate and share ideas, get to a right output to move the solution forward, but it happens in the same ecosystem using virtual networks. 1:32 ¶ 34 in B2 interview 3 September 2025.docx

5.2.1.2. Evidence of business ecosystem innovation readiness

Table 21: Evidence of ecosystem innovation readiness

B3 "You don't have to go and buy a server for it. You can run the space on a AWS or on the cloud for it and it can be deployed the next day. You don't have to go and find skills and put them in your organization. You can range the skills on the net or through companies that are providing virtual skills and or tools to plug them into your organization through your architecture. My advice would always be changing your architecture to be such that you are innovation ready, that you are agile ready. 4:71 ¶ 26 in Research interview _ Gobakwe Maema B3.docx

5.2.1.3. Evidence of partner integration and business ecosystem collaboration

Table 22 : Evidence of partner integration and ecosystem collaboration

T1 Digital transformation, by its very nature, is an ecosystem driven market whereby you can't deliver something, or you can't deliver products alone. There is a share of wallet whereby you bring certain capabilities, you've got partners bringing certain capabilities, you've got internal partners, you've got external partners also bring external capabilities, but you need then to define governance structures in terms of how you onboard those external partners securely in a way that doesn't then expose your digitally, your digital platforms." 2:8 ¶ 3 in Research interview transcript , T1.docx
T1 "there is an external type of sourcing whereby in that strategy you say to deliver who do I partner with or what other building blocks do I need to fulfil my strategy. Then you bring partners that has got these capabilities that you don't have. Hence now a partner first approach is something that is quite key in the digital era "2:33 ¶ 9 in Research interview transcript , T1.docx
T1" There's also a lot of digital interested programs that you need to have in place to make sure that you keep up and you tap into your bringing partners is exactly to say you are the subject matter expert in this space. Most of the ecosystems, sometimes they have an industry specific play." 2:30 ¶ 7 in Research interview transcript , T1.docx
*T1 "It's a shared model for it to work. There's a lot of trust that is required. We need to be trusting each other. We need to be aligned in terms of where we are going. That's why we need to always have these sprints to co-create together and have a shared go to market strategy. We are core selling these. "*2:55 ¶ 17 in Research interview transcript , T1.docx
T1 "It's a case of saying in a one range, how much in that ecosystem are you going to extract? That's why it's always favourable to be the orchestrator of that ecosystem, because everything that plugs into it you can derive value from it. The decision making, you are onboarding it, you are automating it. The rules engine, the workflow sits in your platform but for me it's the core innovation and just understanding that. You are partnering is a partner first approach and your partners are equally important. You don't feel like there is anyone who's bigger because for it to work and fulfil customer and solve customer issues it needs everyone in the ecosystem. " 2:63 ¶ 17 in Research interview transcript , T1.docx
*T1 "Your competitors will probably only wake up when you're in the market with that product so building these, co-creating these ecosystems with the partners, external and internal partners. You are really aligning yourself to go to the market faster and you have customer centric innovation. "*2:42 ¶ 12 – 13 in Research interview transcript , T1.docx
T3 "It's essentially a super app where we as part of this ecosystem, our organization has several markets. It's a big marketplace. You get all the different online guys coming and being part of it and payments can be facilitated easily between them. I think is a nice example of you cannot do everything by yourself. Your part of a bigger system, the ecosystem as it's called, and you play a part. And it often involves revenue sharing 8:27 ¶ 7 in T3 Research Interview.docx
T3 "The government has a, is it an obligation or a desire? But the government is a big thing, they want citizens to have a digital identity, being able to engage with citizens easily, and citizens having access to public services, in health, in transport, whether you're applying for, travelling or whatever it is. They want that and we going to work with government together with several players. The project's called My Mzanzi. You can read about it. It's on the Internet. My Mzanzi. Government is saying, "we can't do this ourselves." They're recognizing there's an ecosystem of players they need. They're saying we need the banks; we need the telcons, we need the insurance guys and so on. We are part of that and we're going to play a part in this. What's it about? It's bringing innovation to the way government engages citizens. 8:36 ¶ 14 in T3 Research Interview.docx

5.2.1.4. Evidence of building networks across organisational boundaries

Table 23: Evidence of building networks across organisational boundaries

T2 *"Now we are able to really respond and keep the network up more than we were doing just based on because you're working for the same company, you are able to benefit or even extend it to third parties, so companies that you work with, you want to be able to at least allow certain services within your company maybe to be accessible with these companies that you work with, subsidiaries, partners or anybody else that you're collaborating with.* 7:3 ¶5 *in T2 Research Interview.docx*
T2 *"Because you're working for the same company, you are able to benefit or even extend it to third parties, so companies that you work with, you want to be able to at least allow certain services within your company maybe to be accessible with these companies that you work with, subsidiaries, partners or anybody else that you're collaborating with."* 7:3 ¶5 in T2 Research Interview.docx

5.2.1.5. In case analysis

Automotive (A)

Only A1 shared their experiences on how their organisation leverages on business ecosystems. This participant discussed how they develop prototypes across different markets within their organisation using virtual networks and sprint-based synchronisation to align.

Banking (B)

Only B2 and B3 shared their experiences about how their organisations leverage and orchestrate business ecosystems. These participants views are different, B2 shared about how they collaborate across abroad teams when working on solutions, while B3 emphasised cloud deployment, sourcing of skills in virtual networks, and ensuring that digital architecture is innovation ready.

Telecommunication (T)

All participants in the telecommunication cluster shared their experiences on how their organisations leverage and orchestrate business virtual ecosystems. This is expected due to the high interaction of the telecommunication (T) cluster with business ecosystems. All three participants expressed different yet interconnected opinions about virtual business ecosystems. T1 emphasizes governance structures, partner onboarding, and the "*partner first*" approach necessary for ecosystem trust and security. T2 elaborates on access to services and networks shared with subsidiaries and partners to enhance interoperability. T3 advances this logic further through examples like the "*super app"* marketplace and the "*My Mzanzi"* initiative, illustrating public–private sector co-creation and revenue-sharing. T1 and T3 have similar views about organisations partnering with others and not doing everything by themselves, organisations partner

with others to achieve their projects and share wallet with these partners. T1 referred to bring external partners while T3 referred to bringing different stakeholders in the public sector and private sector to the virtual ecosystem. They both referred to getting capabilities or subject matter expertise from the ecosystem. T2 has a different view form T1 and T3. T2 referred to interorganisational access to services (between different subsidiaries) from third parties while T3 and T1 referred to co-creation, partnerships with different organisations in the ecosystem.

Manufacturing (M)

No participant in the manufacturing (M) cluster shared experiences on how their organisations leverage virtual business ecosystems.

5.2.1.6. Cross case analysis

The automotive (A) and banking (B) industry emphasised on collaboration across different geographically based subsidiaries, while the telecommunication (T) emphasise the collaboration with external stakeholders. Automotive (A) cluster described agility and sprint synchronisation within their internal virtual teams while the telecommunication (T) described co-creation and shared governance mechanisms and strategic partnerships. The banking (B) cluster and telecommunication (T) cluster both use digital technologies as enablers for innovation; banking (B) emphasised innovation ready architecture, while the telecommunication (T) emphasised on platforms and ecosystems. The telecommunication (T) cluster emphasised being an orchestrator of the ecosystems, while the banking (B) cluster implies the orchestration by highlighting that you plug the companies to your organisation's architecture.

5.2.1.7. Conclusion of theme

The automotive (A) cluster relies on virtual networks mainly to coordinate processes and maintain product consistency across global teams. The banking (B) cluster leverages leveraging cloud infrastructure and modular architecture, thereby transforming virtual networks into platforms that enable agility and innovation readiness. Alternatively, the telecommunication (T) cluster follows an ecosystem-based model, using virtual networks to support collaboration and value creation across different industries.

There is a distinct difference in how the different clusters use virtual networks, for instance the automotive (A) cluster for collaboration with other subsidiaries, banking (B) collaborates through AWS with their ecosystems, and telecommunication (T) orchestrates the ecosystems by onboarding external partners. Collectively, the findings reveal that virtual networks are not the same in every organisation but go with

organisational context and strategy. Virtual networks provide not only the essential infrastructure but also the connections that help today's businesses foster innovation, remain agile, and enhance collaborative in a digitally connected world.

5.2.2. Theme 2: Develop digital big data analytics capabilities

5.2.2.1. Evidence of develop digital big data analytics capabilities

Table 24: Evidence of developing big data analytics capabilities

A2 *"We live in an ecosystem of Wi-Fi or Internet, so that is like you really must have a very stable Internet ecosystem because there are various things running within an organization like for us. If I take an example as the VR that I gave you, it used quite a lot of data. You can imagine using that plus everyone else is also running the different programs and applications on the exact same network."* 3:42 ¶ 15 in Research Interview _ Goba A 2.docx
A2 *"There are legislations in China that will prohibit you from accessing their data. Germany is different. In fact, there's something I need to implement now, for example, to make sure that how do we access data in China, as they don't even use AWS. I think they use their own ecosystem of which we see connect so we need to design it. These key factors would be the infrastructure, the security side of it is so critical in our organization. Without that we will never connect to any market."* 3:45 ¶ 16 in Research Interview _ Goba A 2.docx
B3 *"There's a lot of research houses that deal with trade or even some central reporting entities that are now starting to actually produce big data that are starting to tell us what strategies for people are, what their next best action would be so we're starting to take advantage of these things and connecting our networks to give us next big action, to give us that next lead, to give us that next possible trade, to tell us who we have touched in our own area that we are actually facing who their peers are out there that we're not trading with and what their potential strategies would be so that we can go to them. We would typically never be able to do that if you relied on server to server or peer-to-peer networks because you'd never get the information you're looking for."* 4:11 ¶ 15 in Research interview _ Gobakwe Maema B3.docx
B3 *"One of our strategies as a financial service provider in South Africa, in fact that's one of our core elements as a bank is we fund industries that are green. We go and look for partnerships with agricultural producers or farmers, we build drones for them to go and understand their crop cycle from preparation all the way to harvesting. We do this by partnering with drone providers and digital data providers who go and get data for us and pass it on back to us, when we understand how the farmer works, then that supports the next financial decision, whether we fund them or not, but also whether we give them developmental finance into the future and whether they're green enough if they're not green and if we feel that they are still producing too much emission generating funding, obviously the interest rate comes out because you actually want to discourage that they actually work the way that they do. We do this across multiple industries."* 4:64 ¶ 25 in Research interview _ Gobakwe Maema B3.docx
M4 *"Don't always go for a technology, a particular type of technology, a particular innovation simply because it's fancy or everybody else is doing it. First, you've got to check how does that thing fit your organization in terms of skills, structure and your and your company's dream, your company's vision, your company's purpose. So, whatever innovation or technology or virtual network that you do develop, or build must be fit for purpose."* 12:53 ¶ 13 in M4 Research interview.docx

5.2.2.2. In case analysis

Automotive (A)

Only A2 shared their experiences of how their organisation develops big data analytics capabilities. A2 highlighted the need for a stable internet connectivity for ecosystems and digital infrastructure to support data-intensive digital tools, like such as VR. Further, A2

emphasised infrastructure localisation and data security for different countries as prerequisites for connecting to any market.

Banking (B)

Only B3 shared their experiences of how their organisations develops big data analytics capabilities. B3 described how financial institutions tap into external research houses and trade databases to derive predictive insights from data. B3 also shared an example of the use of drones to gather data to inform "green" investments decisions.

Telecommunication (T)

No participant in the telecommunication (T) cluster shared their experiences of how their organisations develop big data analytic capabilities.

Manufacturing (M)

Only M4 shared their experiences of how their organisation develops big data analytic capabilities. M4 argued that technology adoption, including big data platforms, must be fit for purpose and aligned with existing skills.

5.2.2.3. Cross case analysis

Only the telecommunication cluster did not share their experience on how their organisations develop big data analytic capabilities. The automotive (A), banking (B), and manufacturing (M) clusters all shared different perspectives of data analytics capabilities. Automotive (A) cluster shared about stable WIFI internet connectivity to support high data intensive digital tolls, infrastructure, and security, while banking (B) referred to research houses and trade databases using data for predictive useful insight. Furthermore, the banking (B) cluster highlighted the use of drones for data collection for investment data driven decisions, while the manufacturing (M) cluster emphasised the need for fit for purpose digital technologies.

5.2.2.4. Conclusion of theme

The use of local and secure infrastructure that supports data intensive digital tools was deemed essential as a big data capability. While there is research trading houses produce large amounts of data, it is important to turn this data into useful insights like predictive trading that advice on what the next big move is. There are different digital tools that can be used for data collection, like drones, which can assist in investments data driven decisions. While there is vast amount of incredible digital technologies, t is

important to invest in digital technologies that are fit for purpose. The different clusters shared different views on data analytics and on what they deem important.

5.3.1. Theme 3: Prepare human resources to operate in a digital context

5.3.1.1. Evidence of strategic talent sourcing for digital technologies

Table 25: Evidence of strategic talent sourcing for digital technologies

A2 "We normally go for senior people, but we also do get graduates as well because they've also touched on a lot of the latest software. We kind of bring them in and we also upskill them. It's a two-way thing where we don't just only go for seniors, we want seniors to drive a lot of the initiatives that come because they have the knowledge and they also learning. At the same time the youngsters are coming from varsity because they're fresh minded. We try and see how we can utilize them and grow them into this network." 3:35 ¶9 in Research Interview _ Goba A 2.docx
A2 "Our organization, we have a strategic way of doing it because we're deep within IT and we need people with high tech skills, but from also the business side what we do. We hire more of the senior guys and we love going into place software development companies around and obviously approach them whether we advertise it, but we particularly look for people who are quite good around software development, but also the cloud infrastructure around AWS because this type of skill you need there is if you can develop, it doesn't matter becoming the different programs that you can use." 3:33 ¶9 in Research Interview _ Goba A 2.docx
B3 "With certain digitisation opportunities, you have to go and find people you don't have in your organisation. You must go and hire people from not even South Africa. You will go and find skills internationally and to import those skills. They're scarce in the country. Measure of security, your measure of quality, your measure of trust." 4:52 ¶19 in Research interview _ Gobakwe Maema B3.docx
T2 "we go to the market, and we look for people with that skill set, but also, we go to universities and look for people with potential that can be trained. To support these kinds of systems. Once people are in, we've got to train them in-house. We've got things like leadership trainings, internship, they all come with certain training programs." 7:30 ¶14 in T2 Research Interview.docx
T3: "A few years ago I noticed suddenly there were a lot of job adverts for data analytics, AI and at the same time there was a big drive in the messaging within the organization to saying, you know we're going digital, our organization's going digital, we're going to be a digital company and so on and they were encouraging through bursaries and so forth, go and do digital courses, cloud courses, AI, analytics and so on. Then digital business was a big thing like the course one can do. The internal organisational change organization, the transformation would take a long time, so they went on an aggressive drive to recruit skills in those areas." 8:28 ¶10 in T3 Research Interview.docx

5.3.3.2. Evidence of continuous upskilling and learning

Table 26 : Evidence of continuous upskilling and learning

A2 "As a developer, what we really look for in terms of resource skill is how you continuously upskill yourself, because it is continuously changing. We deliberately look for those types of people so when you look at your career, we just say, you started working 10 years ago, what have you done in terms of training and upskilling yourself?" 3:34 ¶9 in Research Interview _ Goba A 2.docx
M4 "We try to close or manage those gaps through either developing uniform templates that we use in some sections where it can work and sometimes, we send people on training as well. Sometimes it's organized training, but we also have a lot training that are self-paced on our systems." 12:18 ¶5 in M4 Research interview.docx
M4" We send people on leadership training, we send people on awareness trainings, then we have rules and policies that guide how we behave"12:15 ¶5 in M4 Research interview.docx

5.2.3.3. Evidence of partnerships and business ecosystems

Table 27: Evidence of partnerships and business ecosystems

B2 "Sometimes organizations try and do it themselves and then they fail, or they don't get to the right results rather look for. Someone that you can partner with and say this is what I want to achieve, get the right skills and then you move" 1:54 ¶46 in B2 interview 3 September 2025.docx
T1 "There is upskilling of people to always make sure that they are aligned with the technologies that are at play at that time, so there's a lot of upskilling. There's also a lot of digital interested programs that you need to have in place to make sure that you keep up and you tap into your bringing partners is exactly to say you are the subject matter expert in this space." 2:25 ¶7 in Research interview transcript , T1.docx

5.2.3.4. Evidence of human- machine skill integration

Table 5.2.9. Evidence of human machine skill integration

Table 28: Evidence of human machine skill integration

B3 "You start also training your agents to start giving you digital design advice on what you could do to develop the skill. You look for skills in people, but you look also for skills in technology that already exists in agents, which is the agent that we could employ in the organization that does the same thing." 4:53 ¶19 in Research interview _ Gobakwe Maema B3.docx
B3 "Those agents are actually employees because they have to have a performance metrics, they have to have an appraisal, they have to be trained." 4:44 ¶16 in Research interview _ Gobakwe Maema B3.docx
T3 "coupled with that an aggressive amount of training on AWS and Azure to support this migration. So heavy investment in cloud training in IoT type technologies too as we move into this digital space internally. A lot of automation, a lot of use of IoT and coupled with those skills to support that. People have been sent on IoT training, cloud-based training, application development training and so on." 8:21 ¶6 in T3 Research Interview.docx

5.2.4.2. In case analysis

Automotive (A)

Only A2 shared their experiences on how their organisations prepare human capital for digital context. A2 described how their organisation hires high tech senior experienced people with young university graduates, with fresh mindsets, ready for learning. The graduates are trained and grow into the network. A2 also highlighted that developers are expected to continuously upskill themselves since the digital technologies are continuously changing.

Banking (B)

B2 and B3 shared their perspectives of how their organisations prepare human capital for digital context. Both participants share similar different views on the sourcing of skills, however both participants acknowledge the need for digital skills. B3 highlighted the need to source skills outside South Africa due to scarcity, while B2 highlighted partnering with those who are subject matters to leverage their skills. B3 further highlights the use of digital agents instead of looking for skills in people. B2 emphasised the use of partners

like virtual business ecosystems for skills and B3 highlighted international skills and digital agent deployment.

Telecommunication (T)

All participants in the telecommunication (T) cluster shared their perspectives on how their organisations prepare human capital for digital context. T2 shared that they recruit people with skills and university graduates whom they can train, while T3 described the recruitment drive their organisation underwent a recruitment drive for new skills, sponsored bursaries for employees to do courses. Both perspectives share the view that organisations recruit skilled personnel from the market and provide training opportunities, either through internal training programmes or external study courses. The orientation of both T2 and T3 are different, T2 emphasised training and recruiting to support digital systems, while T3 emphasised on recruiting for making the organisation digital, as part of their digital transformation journey. T3 also emphasised the need for training, however, T3 refers to training on the digital infrastructure and architecture cloud-based training, IoT training, app development training. T3 is more specific and explicit about the kind of training an organisation needs to support digital transformation. T1 brought a different view on the recruitment subject, T1 suggested bringing partners who are subject matter experts to assist with upskilling and ensuring people are aligned with digital technologies.

Manufacturing (M)

Only M4 shared their perspectives on how their organisations prepare human capital for a digital context. M4 highlighted the use of standard templates, training programs, including leadership training, and self-paced programs to close the skills gap they experience in their organisation.

5.1.4.3. Cross case analysis

The are similarities in how the automotive (A) and telecommunication (T) clusters recruit senior, skilled people and university graduates, with fresh ideas. Both clusters further offer training and development for both experienced and young employees in their careers. The automotive (A) cluster detailed the need of high-tech skills including software development and cloud infrastructure skills from the people they recruit; however, the telecommunication (T) cluster detailed the kind of training (cloud training, IoT training, application development training) they do for their employees as part of digital transformation; including automation. The banking (B) cluster had a different view

on how their organisation recruits; this cluster described how there is skills scarcity in South Africa, resulting in international sourcing and us of digital agents.

All clusters highlighted different training programs as a necessity for upskilling; however, the banking (B) cluster also highlighted the training and appraisal of the digital agents they employ. The banking (B) and telecommunication (T) clusters described the use of reaching out to partners for lacking skills. However, their use of these partnerships is different. The banking (B) cluster referred to partners bringing skills instead of organisations doing things themselves, while the telecommunication (T) referred to upskilling by bringing partners who are subject matter experts. While all the clusters recognise the need for talent for organisations to operate in the digital context, the methods they employ to get the talent and develop this talent, are different.

5.1.4.4. Conclusion of theme

All the clusters recognise the need for sourcing talent for operating in a digital context, training programs of different kinds are put together to support this. The different clusters employ different methods of sourcing digital skills based on their contexts and strategies. The automotive (A) cluster and telecommunication (T) clusters uses a balance of highly skilled personnel and source university graduates who will be trained and developed into their different roles. Organisations went through aggressive recruitment drives, during their digital transformation journey, where new skills and new roles were created in the telecommunication (T) cluster. It is evident that different continuous upskilling through different training programs, including courses, for both leadership and digital architecture is essential to ensure that the human capital is ready to work in a digital context. The banking (B) and telecommunication (T) clusters described the use of reaching out to partners for lacking skills. However, their use of these partnerships is different. The banking (B) cluster referred to partners bringing skills instead of organisations doing things themselves, while the telecommunication (T) referred to upskilling by bringing partners who are subject matter experts. While digital infrastructure and architecture are important, it is essential to have human capital that will support the use of the digital tools and enhance organisational growth and innovation.

5.3. RQ3: How do MNEs virtual networks that use digital technologies enhance innovation outcomes?

In this section, the evidence for sub-research question 3 will be presented. RQ3 examines how MNEs virtual networks, using digital technologies enhance innovation outcomes. A heat map showing the frequencies of the mention of the different 1st order categories has been illustrated using colour coding, namely green for high mention, yellow for moderate mention, and grey for low or no mention.

Table 29: Heat map for RQ3

Theme	Automobile	Banking	Telecommunication	Manufacturing
Driving new business models		digital marketplace development, exposure to a larger digital market	Exposure to market, generate new revenue streams, Adopt platform based business models	digital marketplace development, exposure to a larger digital market
Streamline R&D processes and reducing costs	Tacit knowledge loss, quick information sharing	Quick processes, quick information sharing	Shorter time to market	Shorter time to product development, quick information sharing
Virtual networks as enablers of customer driven innovation		digital enabled customer experience, moving from product centric to customer centric, omnichannel experience for customers	deliver customer value, co-creation with customer	

5.3.1. Theme 1. Driving new business models

5.3.1.1. Evidence of create a digital marketplace

Table 30: Evidence of create a digital marketplace

B3 *"However, it allows you to integrate with a lot of other potential marketplaces quicker on the net than you would do on server. There's a lot of providers that make their products available on an API. Then you would go and connect with them so that way. A lot of organizations or we from our perspective financial services providers that's becoming more than just a financial service provider. We start becoming a fintech in truth for a solution provider that gives you, there's a bank in South Africa that created a virtual platform to sell everything."* *4:67 ¶ 25 in Research interview _ Gobakwe Maema B3.docx*
M4 *"one of the programs that we have, which we call "Bees", as in the bee that stings you. That system is how we integrate our digital market space; we call it "Bees". So, through that digital market space, we are now able to reach our customers, not only our customers, but even our consumers directly with our products."* 2:56 ¶ 17 in Research interview transcript , T1.docx

5.3.1.2. Evidence of exposure to bigger market

Table 31: Evidence of exposure to bigger market

T1 *"It means you know our exposure; we've got a much bigger exposure to the market because now we are you are selling it as a platform; I'm selling it as a platform. We all are going out, you know the success, there's a better chance of success with us collaborating in that manner."* *2:56 ¶ 17 in Research interview transcript , T1.docx*
M4 *"so the sort of way that the innovation that we undertake in our digital space, in our virtual networks have common objectives. One of them is enabling us to connect more closely with our markets."* *12:56 ¶ 10 in M4 Research interview.docx*

5.3.1.3. Evidence of new business models or new revenue streams

Table 32 :Evidence of new business models or new business streams

T3" Now we got to add to that platform-based business models and so on. You know, as a telecoms provider, the organization I worked for traditionally came from just connecting people, connecting company branches and so on. But now as a technology company, we're saying it's beyond that. Now we we're interested in the digital ecosystem that will connect people, things. That's where IoT comes in. Add-in to that, we interpret the data, we use data analytics, and a key move also is the business models that we are adopting are changing. Now we're thinking about platform-based business models as we have been thinking about in the past." 8:25 ¶ 7 in T3 Research Interview.docx
T3 "digital technologies really at its core when they're used in a bigger ecosystem, they can really assist us as an organization and customers to create new business models. I see the new business model as the hand and feet of a strategy, suddenly you've got a new model for making money. I'm thinking like of the people talk about the Uberization of stuff, suddenly Uber came on board, and they suddenly had the massive taxi business, and you had the guys on the attacking the hotel business, and so on. It can that business model innovation. 8:35 ¶ 14 in T3 Research Interview.docx
T1 *"This also might mean onboarding new partners to deliver different new capabilities; there's always innovation out there that you want to be bringing in to tap into different markets and open new revenue streams for yourself."* 2:17 ¶ 6 in Research interview transcript , T1.docx

5.3.1.4. In case analysis

Automobile(A)

The automobile(A) cluster did not share their experience on how organisations use virtual networks to drive new business models and entrepreneurial models.

Banking (B)

Only B3 shared their experience of how their organisations use virtual networks to create new business models and entrepreneurial models. They noted that virtual networks enable them to connect to markets quicker. Participant B3 noted that the banking business models are changing from just being a financial provider to becoming a Fintech that sells everything.

Telecommunication (T)

Only T2 did not share their experiences on how virtual networks have enabled their organisations to create new business models. T3 mentioned bigger access to the market. Both T3 and T1 shared their experiences on virtual new business models, T3 highlighted how their organisation moved from connecting people through branches to digital ecosystems that connect people. Participant T3 used the example of Uber to explain how virtual networks can be used in bigger ecosystems to create new business models. In addition to this, participant T1 highlighted that onboarding different new capabilities can bring new innovative ways to tap into new markets and open new revenue streams.

Manufacturing (M)

Only M4 share their experience on how virtual networks enable them to create new business models. This participant highlighted how their organisation created a digital marketplace(*"Bees*") that helped them connect with direct consumer of their goods.

5.3.1.4. Cross case analysis

Only the automotive (A) cluster did not share their experiences on how virtual networks create new marketplaces or new business models. The banking (B) cluster highlighted moving from traditional financial services providers to being Fintech companies that sell "everything" on the digital platform. The manufacturing cluster also highlighted the use of a digital marketplace("Bees"); however, they use this marketplace to get closer to their end customers. The telecommunication (T) mentioned using digital marketplaces exposes theme to bigger markets, while the manufacturing (M) cluster described the virtual networks and digital markets to connect them closely with their customers. The banking (B) cluster highlighted the use of API to connect to different digital marketplaces, while the telecommunication (T) cluster highlighted the use of digital ecosystems to connect people, and the manufacturing (M) cluster uses digital marketplace("Bees").Only the telecommunication (T) cluster highlighted onboarding of partners that bring new capabilities that would result in new revenue streams., or using insights derived from data and internet of things (IoT) to move to new business models.

5.3.1.5. Conclusion of theme

The banking (B), telecommunication (T), manufacturing (M) clusters saw value in digital markets; their reasons and how the value is derived is different. banking sector mentioned the move from traditional financial services to fintech, selling everything on digital markets, while the telecommunication (T) cluster talked about exposure to bigger market, new business streams, or new platform-based models. Further, the manufacturing (M) cluster leverages the virtual networks and digital marketplace to get closer to their direct customers. The banking (B) cluster highlighted the use of API to connect to different digital marketplaces, while the telecommunication (T) cluster highlighted the use of digital ecosystems to connect people, and the manufacturing (M) cluster uses digital marketplace ("Bees").

5.3.2. Theme 2. Streamline innovation and operational processes

5.3.2.1. Evidence of streamline innovation and operational processes

Table 33 : Evidence of streamline innovation and operational processes

A2 *"The prototype is also sitting in these three markets, the other two markets as well as in South Africa. Whatever we do here, we need to somehow connect in this virtual network and almost mimic it that side. As much as this part does a certain thing with this prototype, we have to almost mimic it to the other markets, and they have to confirm that it's doing and not breaking their line because we're not always in sync now and again. I think every two weeks we do sync because we work in sprints, so we do sync but when you're working quite in isolation, though you're not necessarily in isolation, but in terms of the software you're working your code and when you test, you need to ensure you test before the two weeks has passed" 3:29 ¶7 in Research Interview _ Goba A 2.docx*
A2 *"In fact, we need to consult with the Research Center in Germany, but that virtual network has enabled us to innovate much faster as also to get information from their side to implement here. It's helped us quite a bit and then in terms of the digital technologies" 3:56 ¶18 in Research Interview _ Goba A 2.docx*
A2 *"We make decisions very quickly though we do, we are aware of the different times so we do like for example now they just wait a little bit for information from the US guys when they wake up and from that I can continue." 3:22 ¶5 in Research Interview _ Goba A 2.docx*
B3 *"Effectively, virtual networks allow you to integrate quickly, to innovate quickly, to digitize quickly, to have access of information and sharing of information much quicker and it also allows you to go through the barriers of creation." 4:17 ¶18 in Research interview _ Gobakwe Maema B3.docx*
T3 *"A lot of these technologies are super-fast in the way they can be deployed, so it can decrease the time to market. "8:34 ¶14 in T3 Research Interview.docx*
T1 *"Is it generating the revenue that or the sales target that we want? It needs to grow with the uptake so that at least you know it can be profitable and also we need to have rapid feedback loops right to understand where it is working, where is it not working." 2:49 ¶17 in Research interview transcript, T1.docx*
M3*" shorter time to product development, new product development cycle, which means from ideation to launch." 10:28 ¶7 in M3 Research interview.docx*
M2 *" You can have meetings, plan meetings happen via teams, so and there's a lot of information that can be shared very quickly using that platform and it just helps to feel to give a feel of you may be talking to someone "9:16 ¶6 in M2 Research interview.docx*
M4 *"You don't need humans anymore to do that because we've developed systems. We have our MES reporting system that are in house built which can extract all sort of information from a machine such as the production time, the maintenance time, the downtime and even analyse, to see what kind of downtime did we have. Did the machine stop because it has its own internal problems, or did it stop because something upstream or downstream prevented it from operating? So, these are some of the ways in which we've developed our in-house capabilities, our in-house part of the virtual." 12:57 ¶5 in M4 Research interview.docx*

5.3.2.2. In case analysis

Automotive (A)

Only A2 had shared their experience on how virtual networks have enabled their organisation on streamlining processes. Participant A2 highlighted the removal of tacit knowledge by virtual networks, especially when getting to know someone online vs physical. To mitigate this, their organisation had a "*compulsory*" travel to "*travel to Germany*" to allow for face-to-face interactions. A2 also highlighted how virtual networks enabled faster innovation and information sharing. A2 also highlighted the use of sprints to sync with their coworkers when working on prototypes.

Banking (B)

Only B3 shared their experience on how virtual networks have enabled their organisations to streamline their processes. This participant highlighted that virtual networks allow them to integrate, innovate, digitalise, and share information quickly.

Telecommunication (T)

Only T3 shared their experiences on how virtual networks enable them to streamline their processes by increasing time to market.

Manufacturing (M)

Only M2 and M4 shared their experiences on how virtual networks have enabled their organisation to streamline their processes. M3 highlighted shorter time to product development while M2 focused on quick information sharing.

5.3.2.3. Cross case analysis

All clusters shared similar views on how virtual networks speed up their innovation and operational processes. Automotive (A) and banking (B) cluster shared how virtual networks help them innovate faster, while the manufacturing (M) emphasised shorter product development cycle. The telecommunication (T) cluster shared a different view about decreasing speed to market. The automotive (A), banking (B), and manufacturing (M) clusters shared a similar view about virtual networks enabling them to share information quicker. However, the automotive (A) cluster warned about tacit knowledge loss and suggested that employees also include face-to-face interactions with their virtual networks.

5.3.2.4. Conclusion on theme

The automotive (A), banking (B), and manufacturing (M) clusters share similar views virtual networks improves the speed and efficiency of information sharing, underscoring their critical role in enhancing innovation agility and operational responsiveness across multinational enterprises. However, the automotive (A) cluster still acknowledged face-to-face interactions as enhancing the virtual relationships, and to avoid tacit knowledge loss.

5.3.3. Theme 3. Virtual networks as enablers of customer driven innovation

5.3.3.1. Evidence of virtual networks as enablers of customer driven innovation

Table 34 : Evidence of virtual networks as enablers of customer driven innovation

B1 "we look at increasing profitability, one of the drivers of profitability is customer experience for example. So then how do we enable the better customer experience? We deploy certain virtual networks to improve the customer experience." 6:11 ¶4 in B1 Research Interview.docx

B1 "It is ensuring that there's a particular customer need that you're catering" 6:29 ¶ 14 in B1 Research Interview.docx
B2 "it's about giving the customer the capability to use our digital components to sell to self-service or self-help them at the end of the day. 1:41 ¶ 39 in B2 interview 3 September 2025.docx
B3 "*You'll notice that I speak a lot about employees and clients because we run an organization that is effectively moving into a more client centric model other than product centric model. What that means is you must care about the voice of the employee facing the line because they know the line better. Therefore, you care about the voice of the line coming in to tell you how you innovate, or you've been designed for them, so the virtual networks allow you to meet the requirements of the client as quickly and less costly as possible".* 4:39 ¶ 11 in Research interview _ Gobakwe Maema B3.docx
B3 "That way it creates experience, it creates a single experience for that organization. It creates both the client and servicing experience. The employee experience faces the client, the client experiences facing the organization. It creates an omnichannel experience that it is an experience that you feel irrespective of where you are if I am interacting with this same organization" 4:7 ¶ 7 in Research interview _ Gobakwe Maema B3.docx
T1 "You know you always see a partner first approach because you want partners that you will trust to deliver with you, and you are able to create that stickiness with the customer because you know you've built a value chain that works optimally and deliver seamlessly customer value. " 2:34 ¶ 9 in Research interview transcript , T1.docx
T3 "We'll build the basic thing, a minimal viable product, test it. What the customers are saying, how it interacts in the real world and then we tweak it. So, it's a different mindset to thinking you know everything and just doing it and giving it to the customer. And very often we bring the customer into the solutioning part of it so that there's a bit of collaboration, a bit of Co-creation with them. So that's our learnings especially when it comes to ecosystems. 8:12 ¶ 4 in T3 Research Interview.docx

5.3.3.1. In case analysis

The automation(A) and manufacturing (M) clusters did not share any experiences on how their organisations customer insights to drive digital transformation. Only the banking (B) and telecommunication (T) had experiences of this.

Banking (B)

All the participants in the banking (B) cluster shared their views about how their customers drive their digital transformation. Participant B2 had a different perspective compared to the other participants; they mentioned giving their customers capacity to use the digital tools for self-service or self-help purposes. In contrast, B1 and B3 referred to deploying virtual networks to improve customer experience. Participant B3 also highlighted the move from a product centric model to a customer centric model. Participant B3 highlighted listening to the voice of employees who understand the customer, "*listening to the voice that tells you how to innovate*" while B1 highlighted customer experience as one of the drivers of profitability. Only Participant B1, mentioned the need to innovate by catering to the customer needs. Participant B3 highlighted the need to create an omnichannel experience throughout the organisation, where customers have the same experience regardless of where they are.

Telecommunication (T)

Only participant T1 and T3 shared their experiences about how their customers drive their digital transformation. T3 highlighted that they include the customer into the solutioning to co-create with them, while participant T1 discussed creating stickiness with the customers and delivering seamless value.

Manufacturing (M)

No experiences were shared by the manufacturing cluster on how their customers drive their digital transformation.

5.3.3.2. Cross case analysis

The banking (B) and telecommunication shared their views on how their customers drive their digital transformation. The difference between their experiences is that the banking (B) cluster focused on customer experience and capacity for customer self-service through digital tools. In contrast the telecommunication (T) cluster focused on including the customer in the solutioning, the customer feedback is also included in the solutioning; they focused on co-creation with customer. The difference between the views of the two clusters is that the banking (B) cluster is internally focused (they aim to enhance customer experience from inside), while the telecommunication (T) is externally focused (they include the customer in the ecosystem).

5.3.3.3. Conclusion of theme

Only the banking (B) and telecommunication (T) clusters shared their experiences on how customers influence their digital transformation. Both banking (B) and telecommunication clusters used virtual networks and digital tools in the drive to be customer centric or focusing on what the customer really wants. Both clusters used different channels to achieve this. The banking cluster focused on enhancing customer experience, increasing customer self-help capabilities, while the telecommunication (T) cluster focused on co-creating with the customer. The banking (B) cluster highlighted creating an omnichannel experience while the telecommunication (T) cluster highlighted seamless customer value through collaboration. The banking (B) cluster mentioned the transition from being product central to being customer centric, while the banking sector focuses on a partner ecosystem approach.

The next chapter discusses the findings in this chapter and compare to literature,

6. Discussion of findings

6.1. Introduction

In this chapter the findings from chapter 5 will be discussed in relation to the literature, depicted in chapter 2. There are eleven themes identified from chapter 5, nine from the literature and new potential new themes. The potential new themes were identified under RQ1 and RQ3, one theme each. This chapter will be organised by research question and each theme under each research question will be discussed in a similar manner as in Chapter 5. Each subsection will be a discussion of the different themes identified under each research question. Each theme will have a conclusion and there will be an overall conclusion for each research question. The updated conceptual framework will be presented after considering the integration of the findings with the literature.

In chapter 5, the author identified two new themes to have emerged from the data collected, namely “create virtual experimentation environment” and “customer driven digital transformation”. The findings will be validated with extra steps that include a a more systematic literature search, from additional scholarly articles. This was done for the author to validate the new themes or any existing similarities and differences between the findings and the literature. A three-step systematic process was followed, with the steps described below

Step 1: The author selected three top articles and conducted a targeted word search where the themes were not identified in the literature review chapter 2.

Step 2: Where there was no mention of the theme, the author identified three top scholars within the international business and digital technologies domains, published within five years and then conducted a word search for the respective theme in those articles. Where there was literature found within these articles, the author continued with their comparison, alternatively, then proceeded to step 3.

Step 3: This step included wider research in google scholar using the specific constructs or themes identified. Where results were found, the author continued to compare literature with findings. However, when all the three steps yielded no results, the author considered the finding as a potential new insight and contribution to literature. As a result of the above-mentioned three steps, new literature was identified and used for discussion in chapter 6, no updates were made to chapter 2.

6.2. RQ1: How do MNEs develop and manage their virtual networks through digital technologies?

6.2.1. Theme 1: Build a digital architecture and infrastructure

6.2.1.1. Literature review updates

There was no literature included in Chapter 2 about applications(apps) development; therefore, the author decided to search for this literature and include in chapter 6 without updating chapter 2. Therefore, a word search "*apps*" or *"applications*" was performed in the Mendeley app in which the scholarly articles for the authors literature are stored, and top three articles that had literature about application development were taken. These articles were by Furr et al. (2022), Grimpe et al. (2023), and Luo(2022b). The literature obtained was as follows:

Digital tools refer to software-based applications and algorithms designed to accomplish specific functions (Furr et al., 2022). These tools can replicate some human abilities, such as pattern recognition and learning, and include applications that support activities, streamline processes, and enhance educational outcomes (Furr et al., 2022). Given the availability of global networks and shared platforms or standards, digital algorithms, apps, or databases can be developed at the subsidiary most capable of the development purposes and rolled out to the rest of the MNE (Grimpe et al., 2023). Furthermore, Grimpe et al. (2023) observed that the nature of digital technologies a subsidiary has favours the emergence of digital expertise as a subsidiary-specific advantage. Luo (2022b) demonstrate the use of apps in developing new business models; this scholar, noted that the use of open software platforms allow third parties to build apps.

6.2.1.2. Discussion of build a digital architecture and infrastructure

The findings revealed that digital architecture must be modular and composable such that when one partner is removed, the system does not collapse. Further, the findings cautioned that digital architecture must not be a barrier to future innovations. These findings have similarities with the views of Zeng et al. (2023) who emphasised that effective management requires integrating global standards with modular frameworks that enable adaptability. Luo (2022) emphasised that the purpose of modularity is to support fast global expansion and assisting organisations to adapt to specific country needs of each host country. The findings mentioned preventing the system from collapse when removing one partner, which is similar to enabling adaptability and fast global expansion.

The findings described the need for digital architecture to be scalable as the virtual network grows, the driver is to "*pay as you grow"* which saves costs. This insight is similar to the views of Luo and Zahra (2023) who emphasised that digital infrastructure must support interoperability, integration, extension, or scalability. Furthermore, Autio et al. (2021) highlighted that scalability of digital architecture enables relatively small headquarters to control and coordinate globally dispersed operations. The findings are different to the literature in the motivation of using scalable digital architecture. The driver for use of scalable digital architecture is saving costs with the "*pay as you grow"* approach, while Autio et al. (2021) referred a driver being for small headquarter control and coordination of globally dispersed operations. Therefore, there are nuances of difference was found in the motivation to use of scalable architecture since the findings are concerned about cost savings but Autio et al. (2021) is concerned about control and coordination.

The findings revealed that subsidiaries can be leveraged for the expertise throughout the organisation, building an app in one country, then deploying it to other countries Cahen and Borini (2020) highlighted the importance of cross-cultural programming skills that enable organisations to design interfaces for global markets without rebuilding the application for every new local market. There are similarities between these findings and insight from Grimpe et al. (2023) who observed that subsidiaries with expertise will develop apps, then these will be rolled out at the rest of the other subsidiaries; this creates subsidiary specific advantage. Furthermore, the findings are similar to Cahen and Borini (2020) who found that developing an app in one country and deploying to other countries requires cross-cultural programming skills.

One of the findings from this study, revealed that some organisations rely on third party start-up companies for app development. Luo (2022b) highlighted, in their conceptual study noted that the use of open software platforms allows third parties to build apps. The findings are similar to Luo (2022b) views.

6.2.1.3. Conclusion of theme

The findings have similarities with the literature Zeng et al. (2023) and Luo (2022) who both highlighted the need for modular architecture that enables adaptability. The findings have similarities with Luo and Zahra (2023) and Autio et al. (2021), highlighting that the digital architecture must be scalable. There nuances of difference are in the motivation or reason why the architecture must be scalable. The findings emphasised the importance of implementing scalable architecture to achieve cost efficiencies, utilizing a

"*pay as you grow"* strategy. However, Autio et al. (2021) emphasised that scalability permits centralised control and effective coordination of geographically dispersed subsidiaries by small headquarters. The findings have similarities with the views from Grimpe et al. (2023) who observed that subsidiaries with expertise will develop apps, then these will be rolled out at the rest of the other subsidiaries; this creates subsidiary specific advantage. Lastly, the findings had similarities with Luo (2022b) who highlighted the use of third-party app developers through open software platforms.

6.2.2. Theme 2: Crafting digital norms and values

6.2.2.1. Discussion of crafting digital norms and values

The findings revealed the importance of having cultural intelligence when dealing with different national cultures, also to build trust by creating personal connections. These findings have similarities with the insights that Hung et al. (2021) where they observed that virtual team leadership, trust and team processes are the ways of achieving team outcomes. Hung et al. (2021) observed the importance of inclusivity as an important factor in virtual teams. Froese et al. (2025) cultural intelligence and international experience as one of the characteristics that a virtual team leader must possess. Further, Froese et al. (2025) observed that information about national cultural contexts or cultural cues can offset negative perceptions about other virtual team members. In the findings, this information may be collected by occasionally travelling to the different countries to experience the different cultures and understand the people better. This is different to what Ahi et al. (2022) suggested in terms of how employees can collect cultural information, these scholars suggested virtual reality and augmented reality cultural immersions as part of training about other national cultures and communication styles. To build onto the findings on the need to visit countries from time and again to understand people better, Galkina et al. (2023) emphasised physical presence as a way of creating long lasting trustworthy relationships, even though they were discussing co-existence (physical and virtual) of network relations in international digital platforms.

Lastly, on culture, one of the findings was that diversity in terms of inputs, interpretations, backgrounds, horizons, and perspectives, as a success factor for virtual networks, especially virtual business ecosystems. These findings share similar insight by Cha (2020) who noted that in business ecosystems, cultural diversity, heterogeneity, and complementarity are what is required.

The findings also revealed that virtual teams need psychological safety to create a learning environment in which employees are allowed to fail and learn from their

mistakes. Scholars Hung et al. (2021) concluded that when working, in virtual teams, managers should create an inclusive atmosphere in which success or failure are regarded a collective outcome of a group, while recognising all team members' contributions. Additionally, Froese et al. (2025) observed that psychologically safe communication climate in virtual teams. The psychological safety identified in the findings was more about the employee's language of appreciation, which was established at the formation of the virtual teams. Therefore, psychological safe communication by Froese et al. (2025) is relevant in this case.

The findings also revealed that change management as one of the key factors that organisations that are "going digital" must consider. The participants refer to changing the way of work and managing the change in technology, people, and architecture. Similarities exist between these findings and those observed by Bhandari et al. (2023) in their study, that organisational change management is a key factor that influences the relationship between digitalisation and performance. They further noted that successful change management that embeds digital transformation within an organisation leads to higher efficiencies and improved effectiveness. With regards to 'shifting the way of work', Vuchkovski et al. (2023) observed that virtual adoption may lead to introduction of new roles which require change management. The findings are similar to the literature highlighted.

6.2.2.2. Conclusion of theme

The findings highlighted that effective virtual collaboration in MNEs depends not only on technological enablement but also on cultural intelligence, psychological safety, and adaptive change management. The findings are largely similar to Hung et al. (2021) and Froese et al. (2025), who emphasise inclusivity, trust, and culturally sensitive leadership as essential for achieving virtual team outcomes. The findings suggested periodic physical interaction (periodic visits to countries) remains critical for building trust-based relationships across borders. However, the findings showed nuances of difference from what Ahi et al. (2022) proposes on using digital means like virtual or augmented reality immersions, to bridge to foster cultural understanding. These findings are similar to those suggested by Galkina et al. (2023) that physical presence is a way of creating long lasting trustworthy relationships.

The finding also revealed that showing language of appreciation in virtual teams, these are similar to Froese et al. (2025) who highlighted the need for psychological safety within virtual networks. Finally, the findings revealed change management as important

for “going digital “MNEs, these are similar to the views of Bhandari et al. (2023) and Vuchkovski et al. (2023) who both noted the need for change management during digital transformation.

6.2.3. Theme 3: Creating virtual experimentation environments

6.2.3.1. Update literature of create virtual experimentation environments

The literature the author included in chapter 2 about create virtual experimentation environments was related to simulations (Froese et al., 2025) and developing prototypes (Dachs et al., 2024). There was no literature about some of the experimentation processes since the concepts of virtual sandboxes and virtual hackathons emerged during the data gathering process. Therefore, the author performed the literature search as described in steps in paragraph 6.1.

Step 1 was followed by searching and yielded no results in the author’s current articles used for literature survey.

Authors	**Article title**	**Journal of Publication**
Autio, E., Mudambi, R., & Yoo, Y.	Digitalisation and globalisation in turbulent world: centrifugal and centripetal forces	*Global Strategy Journal (2021)*
Zahra, S. and Mudambi, R.,	Leveraging the interplay of digitalisation and mobile resources to promote MNE entrepreneurship	*Global Strategy Journal (2025)*
Ahi, A.A., Sinkovics, N., Shildibekov, Y., Sinkovics, R.R, & Mehandjiev, N.	Advanced technologies and international business: A multidisciplinary analysis of the literature	*International Business Review (2022)*

No literature was found in these listed articles, therefore step 2 was followed.

Step 2: A Google Scholar search for top three authors was conducted to review their scholarly articles which may have information about virtual experimental environments, Autio, E., Luo Y., and Froese, F. in the field of digital technologies and international business.

Step 3: A Google search was done for the following words for scholarly articles published in the past five years.

“Virtual experimentation environments”,” virtual innovation arenas”, “virtual sandboxes”,” regulatory sandbox” “virtual hackathons”.

Results were obtained for virtual hackathons and for virtual sandboxes, and not for ‘Virtual experimentation environment".

The results yielded some articles published within the past five years, however, for virtual hackathons there were low quality journal articles. For example, “*Managing attention in virtual hackathons: Effective configurations of team external communication”* by Ivanovic et al. (2022) from *Academy of Management Annual Meeting Proceeds,* for virtual Hackathons*. The journal ranking was checked on Academic Journal Guide 2021* and it is not on the list.

The high-quality journal that yielded literature about virtual or regulatory sandboxes was “*Exploring how social interactions influence regulators and innovators: The case of regulatory sandboxes*” by Alaassar et al. (2020), from *Technological forecasting & Social Change*. *The journal ranking was checked on Academic Journal Guide 2021 to be a 3, which a good quality journal and can be used.*

Regulatory sandboxes allow participants temporary licensing exemptions to test solutions under regulatory conditions, encouraging innovation in financial and fintech organisations (Alaassar et al., 2020). Regulatory sandboxes not only provide a controlled environment for experimentation but also enhances sandbox participants’ legitimacy and credibility with investors and customers Alaassar et al. (2020) . Further, Alaassar et al. (2020) observed that regulatory sandboxes can enhance participants’ credibility, making it easier for them to connect with external networks by reducing perceived risk and encouraging social exchange.

6.2.3.2. Discussion of create virtual experimentation environments

The findings described that organisations must create virtual experimentation environments to stimulate and accelerate innovation. The findings revealed the use of virtual hackathons as facilitation for cross functional, collaborative innovation environments for solving complex business challenges. According to Luo (2021), digitally mediated collaboration is a key driver of digital globalization, improving innovation through open innovation platforms and global virtual networks. The findings have similarities to those by Luo (2021), since virtual hackathons are digitally collaborative environments within global virtual networks (internal in this case), and improve innovation.

The findings revealed that cross-functional exposure during onboarding inspired an employee's innovative idea during a virtual hackathon. Drawing on experience from their training in the automotive product department, the employee adapted a feature for use in the IT environment when participating in a virtual hackathon. New developments in digital technology make it easier to create, share, and exchange increasingly complex and tacit knowledge across geographically dispersed subsidiaries (Autio et al., 2021). The findings have similarities to the conceptual views by Autio et al. (2021) in that they demonstrate that digital technologies enable sharing and exchange of tacit knowledge across subsidiaries. The employee used their tacit knowledge to come up with an innovative idea and was able to share this across other subsidiaries via virtual hackathons.

According to Teece (2025) ongoing improvement and regular experimentation encourage unique, exceptional capabilities, which also support knowledge sharing and integration among various subsidiaries, strengthening knowledge building processes. The findings share similarities with the conceptual views of Teece (2025); regular experimentations encourage unique capabilities that support knowledge sharing among subsidiaries. The difference is that the findings describe innovation as an outcome, but literature describes stronger knowledge building processes as an outcome.

Since there was no specific literature found about hackathons from high quality journals in the past five years, this makes virtual hackathons, under the theme of creating a virtual experimental environment, a potential new insight from this study.

The findings revealed virtual or regulatory sandboxes as a way of creating an experimental environment for innovation. The findings suggest that virtual sandboxes bring people across borders in a protected environment to collaborate on innovations. The regulations in these environments are "*relaxed"*, people are allowed to experiment digitally, in collaboration with global participants. Scholars, Alaassar et al. (2020), has similar views but emphasised that the regulatory sandboxes enhance the legitimacy and credibility of participants in the eyes of the investors and customers. The findings described similar views to Alaassar et al. (2020) indicating that regulatory sandboxes bring people together easily, encouraging social exchange. The findings described the regulatory sandbox environment as a *"relaxed"* space for experimentation. However, Alaassar et al. (2020) clarified that this "relaxed" environment implies that participants are granted temporary exemptions, enabling them to test solutions within regulatory guidelines.

The author identified “create virtual experimentation environment” as a possible new insight. However, further systematic literature review revealed that some experimental processes related to this theme already exist. Despite this, the specific theme of “create virtual experimental environments” was not found in existing literature, so the author regards it as a new theme. Furthermore, regulatory virtual sandboxes have already been discussed in the literature; however, no references to virtual hackathons were identified in recent studies (within the past five years). Therefore, virtual hackathons were identified as potential new insight. Accordingly, the conceptual model will be revised to incorporate this theme as reflected in existing literature, while also highlighting virtual hackathons as a potential new insight within this context.

6.2.3.3. Conclusion of theme

There was no literature on virtual experimentation environments like virtual hackathons and virtual regulatory sandboxes, in chapter 2. Upon a further literature research, the author found one high quality scholarly article for virtual regulatory sandboxes. This literature was added to this chapter. The findings were found to be similar to what was in the literature. The author did not find any high-quality scholarly articles describing virtual hackathons.

The author had highlighted ‘create virtual experimentation environment’ as new insight, however, after the additional systematic literature search, some processes under the theme already existed, like virtual regulatory sandboxes. However, the theme create virtual experimentation environment was not found in the systematic literature. Regulatory virtual sandboxes have already been discussed in the literature; however, no references to virtual hackathons were identified in recent studies (within the past five years). Therefore, virtual hackathons were identified as potential new insight. Accordingly, the conceptual model will be revised to incorporate this theme as reflected in existing literature, while also highlighting virtual hackathons as a potential new insight within this context.

6.2.4. Theme 4: Implementing governance mechanisms

6.2.4.1. Discussion of implementing governance mechanisms

The findings presented the use of project charters and rules of engagement, use of VPN to control access, compliance standards, rules, and regulations frameworks, as control mechanisms for digital technologies. Ahi et al. (2022) suggested a carefully drafted contract as a mechanism of governance and control since this lowers cost of control. Furthermore, Meyer et al. (2023) recommended that platform owners establish access

and control rules and use of blockchain contracts to reduce risks and uncertainty. The findings are similar to the views of scholars Ahi et al. (2022) and Meyer et al. (2023) in the use of contracts, access control, and control rules.

The findings indicate that the governance frameworks implemented by organisations comply with national regulations governing data exchange, including jurisdictional, data sharing, and privacy laws specific to each country. The study by Luo (2022a) showed that digital risks associated with participating in ecosystems or virtual networks need greater data and information processing, thus the use of information policies between host countries and home country, or even with foreign ecosystems. The findings have similarities with Luo (2022a) in the emphasis of the use of governance frameworks or information policies between the different countries.

6.2.4.2. Conclusion of theme

The findings presented under the theme of implementing governance mechanism were found to be similar to the literature. The findings are similar to the views of scholars Ahi et al. (2022) and Meyer et al. (2023) in the use of contracts, access control, and control rules. The findings have similarities with Luo (2022a) in the emphasis of the use of governance frameworks or information policies between the different countries.

6.2.5. Theme 5: Develop digital connectivity intelligence

6.2.5.1. Discussion of develop digital connectivity intelligence

The findings revealed that each region or cluster in a MNE builds its own virtual network for its specific purpose but connects to the main architecture through shared data or information domain. The region generates and processes data within their federated networks, then share centrally to use across the entire organisation. Furthermore, federated networks feature a central controller overseeing the network, with additional controllers supporting distribution across various regions. These findings have similarities with those of scholars, Vuchkovski et al. (2023) , who emphasised that the success of digital transformation depends on creating a centralised system and solid infrastructure. The use of federated networks highlights local autonomy, with central coordination, which avoids a single point of failure described in the findings. These findings present a nuance of different from the views of Meyer et al. (2020) who noted that the strategic challenge for MNEs remain to use digital technologies to balance control with autonomy, achieving global efficiency and encouraging local innovation. The use of federated networks somehow balances the forces of control and autonomy of the

headquarters and subsidiaries; there is still control but the subsidiaries can still be autonomous.

Moreover, the findings described one participating MNEs operates through central hubs or research centres based in different countries; one dedicated to digital maintenance challenges and another serving as an innovation centre or R&D centre. All innovation initiatives are channelled through this innovation centre. Zeng et al. (2023) argued that centralising and standardising routine activities across subsidiaries, or global value chains, or any collaborating organisation, can enhance overall efficiency, when facilitated by digital technologies. The findings have similarities with Zeng et al. (2023) views; centralising and standardising innovation initiatives (or R&D) in one hub and maintenance initiative in another. However, the nuances of difference between the findings and literature are that the findings are referred to centralised hubs based on specialised expertise and strategic focus areas within the organisation, while Zeng et al. (2023) referred to headquarters level centralisation. However, the findings were similar to Luo (2021) who described that frontline subsidiaries or hubs have distinct mandates and local context specific strategic objectives, and Benito et al. (2022) who highlighted the need for accessibility to decision making power across the MNE to leverage opportunities present in the diverse local contexts.

The findings revealed that virtual networks enhance accessibility, speed, and collaboration, global connectivity by enabling quick data exchange, quick integration. This is similar to Luo (2021) who highlighted that digital connectivity makes intra organisational collaboration, sharing, and learning easier, productive, and efficient (Luo, 2021). However, the findings highlighted the challenge with accessibility to digital tools or technologies, especially in areas with less connectivity (no network access). Adomako et al. (2024) note that in many regions of Africa, internet access is still largely confined to urban areas. This restriction hampers real-time communication, collaboration, and access to online resources, which in turn affects business agility and responsiveness. This finding highlights the challenges that MNEs face in different host countries.

The findings revealed that various MNEs have integrated digital tools into the management and coordination of their virtual networks. The digital tools identified within the findings include augmented reality (AR) for virtual meetings, machine learning (AI) and robotic agents for market intelligence and anticipating trade trends, embedding AI within platforms to generate actionable insights, and automated data capture for streamlined report generation. Furthermore, the use of AI in mining unstructured data

and turning it into useful insights within the virtual networks, was highlighted. These findings have similarities with Luo (2022b) who highlighted that digital connectivity encompasses integration of digital technologies (ICT, cloud services, IoT, AI, blockchain, and data analytics) into all functions and locations of the MNEs, and generating intelligence that fosters continuous innovation, and flat decision making. The difference between the findings and the literature is that the findings highlight a challenge of digital transformation reaching areas with no connectivity, the literature does not address this. This presents a challenge that needs to be addressed by MNEs that happen to be present in host countries that have digital connectivity or network challenges.

6.2.5.2. Conclusion of theme

There were similarities and some differences between the findings and the literature presented. The findings revealed that MNEs use federated virtual networks to link regional autonomy with central coordination, enabling data sharing, collaboration, and innovation across dispersed subsidiaries. These findings have similarities with Vuchkovski et al. (2023) and (Luo, 2021), who emphasised the value of centralised infrastructure and digital connectivity for effective knowledge integration. However, there findings were different to with Zeng et al. (2023) who associated centralisation with headquarters control. The findings emphasised a distributed form of centralisation based on specialised hubs also focusing on local contexts, while literature emphasised control from the headquarters.

The findings also revealed that MNEs increasingly embed digital tools such as AI, machine learning, robotic agents, and augmented reality within their virtual networks to enhance connectivity, speed, and decision-making. This is similar to Luo (2022b), who highlighted that digital connectivity involves the integration of technologies like cloud computing, IoT, and data analytics across all functions to generate intelligence and foster continuous innovation. However, the difference lies in the fact that the findings emphasise the persistent inequalities in digital access and infrastructure across regions (areas of no connectivity), while literature assumed seamless global digital integration.

6.2.6. Conclusion of RQ1

Research question 1 addresses how MNEs develop and manage virtual networks, whether internal of external. Five themes were identified for RQ1, with one potential new theme. The findings were found to be similar to existing literature on most themes identified under RQ1. The nuances of differences were identified under the following themes: build digital infrastructure and architectures, crafting norms and values, and

create virtual experimentation environment. The key differences between the findings and the literature were on hackathons as a process used for virtual experimentation, and the theme create an experimentation environment, also on the fact that the findings highlighted the areas that have no connectivity (internet) in the digital transformation journey.

6.3. RQ2: How do MNEs build capabilities to harness digital technologies in virtual networks

6.3.1. Theme 1: Leveraging and orchestrate virtual business ecosystems

6.3.1.1. Discussion of leveraging and orchestrate virtual business ecosystems

The findings revealed that digital transformation drives organisations into an ecosystem driven market, in which they cannot deliver products or services on their own. These ecosystems are characterised by bringing certain capabilities through partners, sharing the wallet, and defining governance structures to onboard external partners securely. The findings have similarities with the views by Meyer et al. (2023) who emphasised that organisations are developing digital strategies to create new business models and shifting costs and activities from their own to partners, complementors, customers, and other stakeholders at home or abroad. Additionally, these findings have similarities with the views of Cahen and Borini (2020) who highlighted that virtual partnerships enable organizations to share digital assets, making it quicker and more efficient to attract and reach users or customers in new international markets. Further, the findings highlight the share of wallet, which is similar shared virtual sales and digital resources mentioned by Cahen and Borini (2020). In the same light, the findings are similar to Furr et al. (2022) who highlighted that by participating in a collaborative business ecosystem organisations can distribute the costs associated with delivering goods and services among various partners while gaining access to capabilities that may have previously been unavailable.

The findings showed that trust and alignment are important factors for successful co-creation within ecosystems, facilitating a shared go-to-market strategy and collaborative selling efforts. These findings are similar to those by Spaniol and Rowland (2022) and Mubarak and Petraite (2020) who emphasised that virtual business ecosystems require multilateral alignment and trust; these can be established by using shared standards, contract rules, and modularity of the platforms. Furthermore, the findings are similar to Mubarak and Petraite (2020) who highlighted that digital trust strengthens open innovation performance and competitiveness of globally networked MNEs.

The findings indicated that to extract more value from an ecosystem, it is advantageous to be the orchestrator. As an orchestrator, you are the decisionmaker for onboarding, automation and workflows that occur in your platform. The core of collaborative innovation is maintaining a partner-first approach, where every participant is equal, and to solve customer challenges together. These findings are similar to the views of Benito et al. (2022) and Furr et al. (2022) who highlighted that a virtual ecosystem orchestrator defines the relevant ecosystem architecture and convince others to join, partners. The findings described the *partner-first approach*, where all virtual ecosystem participants are equal. This is similar to the views by Cha (2020) who highlighted that there is a need for decentralisation of authority or disintegrated organisations when it comes to virtual business ecosystems.

The findings revealed that through virtual ecosystems cocreation may involve different players from the public sector (government) or from the private sector to solve social challenges the government in working on. The findings highlighted an example of a project the MNE is currently working on with the government and other organisations in this ecosystem. These findings are similar to Cha (2020), who noted that business ecosystems include supply chains, government regulatory organisations, stakeholders, and other entities that share similar products or services.

6.3.1.2. Conclusion of theme

The findings were similar to the literature presented and no differences found. The findings had similarities with Meyer et al., (2023), Cahen & Borini (2020), and Furr et al. (2022) showing that digital strategies, virtual partnerships, and collaborative business models redistribute activities across networks of partners to enhance speed, reach, and innovation. The findings also emphasise that trust, alignment, and shared strategic intent are essential for effective co-creation and collaborative selling, reinforcing insights by Spaniol and Rowland (2022) and Mubarak and Petraite (2020) regarding the importance of multilateral trust and platform modularity for sustaining open innovation in digitally connected networks. Furthermore, the findings were similar to perspectives of Benito et al. (2022) and Furr et al. (2022) who emphasised that the orchestrating organisation defines platform architecture, governs onboarding and automation. The findings also highlight the *partner first approach*, where all actors are equal, which is consistent with the views of Cha (2020). Finally, the findings reveal that virtual ecosystems extend beyond private sector collaboration to include public actors, enabling cross-sector co-creation around complex societal problems, consistent with Cha (2020) view that modern

ecosystems involve governments, regulators, stakeholders, and organisations with shared objectives.

6.3.2. Theme. 2: Develop digital data analytics capabilities

6.3.2.1. Discussion of develop digital data analytics capabilities

The findings revealed that there is a need for a stable internet connectivity for ecosystems and secure digital infrastructure to support data-intensive digital tools, like such as VR. Furthermore, data access to countries, like China, who have legislation that prohibits other countries to access their data, remains a challenge. These findings are similar to Furr et al. (2022). who emphasised that data is now governed by regulatory constraints and requires MNEs to develop country specific virtual ecosystems that can protect data transfer in compliance with local or host country regulations. Furthermore, the findings highlighted the need for stable internet connectivity support data intensive digital tools; these are similar with Luo(2022a) who noted that digital connectivity relies on digital platforms, ICT, internet and intranet access, as well as technologies like big data, cloud services, and data analytics.

The findings showed how financial institutions use external research houses and trade databases (through virtual networks) that produce big data which is used to derive predictive insights to inform people of the next big action. The findings highlighted producing data which is used to derive predictive insights; this is similar to the views by Mubarak and Petraite (2020), who noted that business virtual networks produce vast amounts of both structured and unstructured data which is captured, transmitted, stored, and analysed to support decision making. Furthermore, the findings are similar to Ahi et al. (2022) and Luo (2022a) who highlighted that digital tools (like blockchain, IoT, and big data analytics) can be used to improve real-time decisions by efficient data capturing, storage, sharing, and generating intelligence.

The findings showed that digital technologies are used to gather unstructured data which can be used for due diligence by investment houses. In this case drones were used to gather data from a farm to inform green investment decisions. The findings revealed that the data collected from drones with be used for investment decision, this has similarities with Fleury et al. (2024), who emphasised that integrating data-driven decision-making into global value chains helps MNEs and their ecosystems stay competitive.

6.3.2.2. Conclusion of theme

The findings were found to be similar to the literature. No differences were found. These findings are similar to Furr et al. (2022) who emphasised that data is now governed by regulatory constraints and requires MNEs to develop country specific virtual ecosystems that can protect data transfer in compliance with local or host country regulations. The findings highlighted the need for internet connectivity to support data intensive digital tools; this is similar to Luo (2022a). the findings highlighted the need for converting structured or unstructured data into useful insights for decision making, this had similarities with Mubarak and Petraite (2020). The findings are similar to Ahi et al.(2022) and Luo (2022a) who highlighted that digital tools (like blockchain, IoT, and big data analytics) can be used to improve real-time decisions by efficient data capturing, storage, sharing, and generating intelligence. The findings revealed that the data collected from drones with be used for investment decision, this has similarities with Fleury et al. (2024), who emphasised that integrating data-driven decision-making into global value chains helps MNEs and their ecosystems stay competitive

6.3.3. Theme 3: Preparing human resource for digital context

6.3.3.1. Literature update of preparing human resource for digital context

A literature update on some of the concepts that emerged in the findings was required since not everything was covered in chapter 2. There was no literature in chapter 2 about the hiring of young university graduates for digital roles and mentorship provided by the senior talent. The update on the literature review is also essential for explaining whether the findings already exist in literature or they are potential new insights. The steps explained in paragraph 6.1 were followed.

Step 1 was followed; the following articles were searched for literature explaining recruitment of university graduates and their upskilling by provision of mentorship by senior employees.

Table 35: Scholarly articles reviewed

Authors	Article title	Journal of Publication
Froese F.J., Blay, T., Gibson, C.B., Shaffer, M.A., & Benitez, J.	Global virtual work: a review, integrative framework, and future research opportunities.	*Journal of International Business Studies (2025)*

Montero Guerra, J.M., Danvila-del-Valle, I., & Ménez-Suárez, M.	The impact of digital transformation on talent management	*Technological forecasting & social change(2023)*
Grimpe, C., Sofka, W., & Kaiser, U.	Competing for digital human capital: The retention effect of digital expertise in MNC subsidiaries	*Journal of International Business Studies (2023)*

No Literature about hiring fresh university graduates was found in these articles. Therefore step 2 was followed.

Step 2: A Google Scholar search for top three authors was conducted to review their scholarly articles which may have information about virtual experimental environments, Dahms S., Luo Y., and Froese, F. in the field of digital technologies and international business. No results were yielded.

Step 3: A Google search was done for the following words for scholarly articles published in the past five years. “Hire university IT graduates”, “dual tier hiring”, “hire university graduates and highly skilled workers.”

No results were obtained. Therefore, the hiring of fresh university graduates and highly skilled workers at the same time was a potentially new insight.

6.3.3.2. Discussion of preparing human resource for digital context

The findings showed that organisations source digital talent by hiring experienced high-tech professionals along with fresh university graduates. This combination is beneficial because senior experts can mentor and upskill fresh university graduates who are enthusiastic about learning and bring fresh perspectives. The fresh university graduates bring new perspectives and have been exposed to the latest digital technologies through their studies. One participant shared a detailed example of the new roles and expertise their organisation needed during its digital transformation. They also noted that the organisation initiated a skills recruitment drive, offering bursaries, courses, and other opportunities for professional development. The findings that new roles emerged during digital transformation are similar to those from the study by Vuchkovski et al. (2023). These scholars found that building new capabilities may transform virtual team challenges into organisational innovation, with emergence of new roles, structural changes and new ways of learning. Dahms et al. (2020) concluded that for superior innovation performance, MNE organisations IT advancements, competencies, and

strong external or internal networks. Furthermore, it is important to attract, recruit, develop, and motivate highly skilled workers who can solve complex problems and utilize data (Fleury et al., 2024) . The findings have similarities with the conclusion by Dahms et al. (2020) and Fleury et al. (2024).

The nuances of difference in the findings is in the fact that the organisations follow a dual tier hiring approach where they recruit skilled workers and fresh university graduates. The fresh university graduates are hired for their enthusiasm to learn, fresh perspectives, and the exposure to the latest technologies through their studies. In this way, a talent pipeline is created. There was no literature found on recruitment of fresh university graduates as part of digital transformation of organisations.

The findings showed that organisations should partner with others who have the necessary skills (subject matter expertise), rather than attempting everything alone and risking failure. Digital connectivity enables MNEs to leverage global freelance expertise in areas of internal skill deficiency, offering a more cost-effective, flexible, and agile alternative to traditional in-house talent (Luo, 2021). The findings have similarities with eh view by Luo (2021) since both refer to leveraging external skills or expertise. Furthermore, the findings are similar to Froese et al. (2025) who emphasised that digital platforms or ecosystems are used for distributed talent orchestration, where expertise is accessed and activated across geographies without physical relocation.

The findings revealed that organisations can employ robotic agents to give digital design advise for projects instead of using people. These robotics agents have performance metrics and appraisals. The findings are similar to perspectives of Ahi et al. (2022), who noted that modern robots work more independently, adapt better, collaborate effectively, manage complex jobs, and interact with both humans and other robots, since they rely on machine learning.

6.3.3.3. Conclusion of theme

The findings were similar to the literature presented. The nuances of difference was in the findings in the recruitment strategy for IT personnel, where organisations hire highly skilled workers and fresh university students. The dual tier strategy is for the skilled workers to mentor the fresh university graduates, while fresh university graduates bring fresh perspectives and are eager to learn. The literature refers to only hiring of highly skilled workers during the digital transformation journey.

The findings were similar to Dahms et al. (2020) and Fleury et al. (2024). Dahms et al. (2020) found that for superior innovation performance, MNE organisations IT advancements, competencies, and strong external or internal networks. Meanwhile, Fleury et al. (2024) found that it is important to attract, recruit, develop, and motivate highly skilled workers who can solve complex problems and utilize data. The finding s revealed that it is important to onboard subject matter expertise instead of doing everything yourself. These were similar to Luo (2021) who emphasised that digital connectivity enables MNEs to leverage global freelance expertise in areas of internal skill deficiency, offering a more cost-effective, flexible, and agile alternative to traditional in-house talent.

6.3.4. Conclusion of RQ2

The findings in are similar to the literature. One nuance of difference was highlighted.; this was the dual-tier recruitment strategy where highly skilled workers are hired with fresh university graduates. The findings highlight that MNEs increasingly depend on virtual business ecosystems to access complementary capabilities, accelerate innovation, and co-create value across borders. These ecosystems require strong governance, trust, alignment, and a partner-first approach, consistent with the views of Meyer et al. (2023), Cahen and Borini (2020), Spaniol and Rowland (2022), and Furr et al. (2022). The role of the ecosystem orchestrator emerged as particularly significant in defining platform architecture, overseeing onboarding, and ensuring equitable participation.

MNEs rely on digital data analytics capabilities to generate intelligence that supports distributed decision-making. Reliable connectivity, secure infrastructure, and regulatory compliance become foundational enablers for using data-intensive tools such as VR, drones, and big data platforms. This aligns with the literature (Furr et al., 2022; Ahi et al., 2022; Luo, 2022a; Mubarak & Petraite, 2020), which highlights the centrality of digital infrastructure and analytics in real-time decision environments.

The findings revealed that MNEs develop advanced human capabilities through a dual tier hiring approach that combines senior digital experts with fresh university graduates, supported by mentorship and ongoing upskilling. At the same time, MNEs supplement internal skills by accessing global freelance expertise (Luo, 2021) and by integrating robotic agents capable of performing digital tasks (Ahi et al., 2022).

6.4. RQ3: How do MNEs using digital technologies enhance innovation outcomes through virtual networks?

Three themes were identified for RQ3, where one out of three was marked as potential new insight. Customer driven digital transformation was identified as a potentially new theme.

6.4.1. Theme 1: Driving new business models

6.4.1.1. Discussion of driving new business models

The research revealed that MNEs are leveraging virtual networks and APIs to engage with their markets more rapidly with their markets by connecting to multiple virtual marketplaces. For instance, one participant described how a traditional MNE, developed its own virtual marketplace, "*Bees",* to reach end consumers directly. Previously, their standard route to market was primarily through distributors but now they have added a new route to market. Through these virtual networks, organisations gain access to larger markets and facilitate enhanced collaboration with their partners and customers across different geographies. This is what Zeng et al. (2023) referred to an ecosystem innovation. These findings are similar to the view of Zahra and Mudambi (2025) who highlighted that the use of digital technologies provides new opportunities for customer engagement, new revenue generation, access to new markets, and adaptation to changing consumer preferences. In the same context, the findings are similar to Bhandari et al. (2023) who argued that digital transformation equips organisations with capabilities to drive new market expansion, allowing for greater economies of scale. The use of "Bees", digital platform or marketplace, demonstrate what Volberda et al. (2021) cautioned about traditional MNEs; they require redesign of legacy structures to support agile new business models. This is exactly what this MNE had done by tapping into a new market through "Bees". Another similarity is the adaptation to changing consumer preferences; by using "Bees", the MNE can reach out to the younger consumers who are digitally savvy and do not want to physically go to the stores. The difference between the findings and the literature is that this MNE still kept their traditional route to market and used the virtual digital platform as an add on route, without necessarily changing their business model.

Further, the findings that revealed that traditional MNEs are replacing their old models of connecting people through branches, to becoming digital marketplaces that connect

people virtually. According to Furr et al. (2022), when MNEs embark on digital transformation initiatives, they gain access to the information necessary to develop new business models and pursue emerging market opportunities. Furthermore, digitalization enables new business models that shift the locus of innovation and value creation to globally dispersed networks (Bouncken et al., 2023). The findings are similar to those by Furr et al. (2022) and Bouncken et al. (2023). Achieving the same objective of "connecting people" by moving from physical branches to virtual digital marketplace is a form of pursuing emerging markets, where banks move to virtual branches and adopt fintech models.

The findings revealed that onboarding different new capabilities can bring new innovative ways to tap into new markets and open new revenue streams. According to Furr et al. (2022) participating in a collaborative business ecosystem enables organisations to distribute the costs associated with delivering goods and services among various partners while gaining access to capabilities that may have previously been unavailable. These findings are different to the literature since Furr et al. (2022) emphasised that in collaborative business ecosystems, organisations access new capabilities they previously had no access to, but the findings highlight that bringing new capabilities enables innovation thus tapping into new markets and revenue streams. Literature often referred to the use of digital tools enabling development new revenue streams and new markets (Zahra & Mudambi, 2025), rather than the onboarded partner capabilities derived from these ecosystems enabling tapping into new markets.

6.4.1.2. Conclusion of theme

The findings revealed that MNEs are using virtual networks, APIs, and digital marketplaces to enhance their market reach, customer engagement, and partner collaboration across geographies. The example of "Bees" illustrates how a traditional MNE can expand its routes to market by adding a digital marketplace that complements, rather than replaces, its existing distribution channels. This reflects a broader shift toward *ecosystem innovation* (Zeng et al., 2023), where value is created through digitally connected networks of partners and customers. Similar to the views by with Zahra and Mudambi (2025), Bhandari et al. (2023), and Furr et al. (2022), the findings highlight how digital transformation enables MNEs to access new markets, develop new revenue streams, and adapt to evolving consumer preferences.

The difference between the findings and the literature is that this MNE still kept their traditional route to market and used the virtual digital platform as an add on route, without necessarily changing their business model. Another difference found is that the findings emphasised that the capabilities derived from the onboarded partners may be used as part of innovation to tap into new markets and business streams. However, literature often referred to the use of digital tools enabling development new revenue streams and new markets (Zahra & Mudambi, 2025).

6.4.2. Theme 2: Streamlining R &D processes and reducing costs

6.4.2.1. Discussion of streamlining R &D processes and reducing costs

The findings revealed that virtual networks make it easier for teams in different locations to collaborate on prototypes while working on projects with global teams. These networks help MNEs innovate faster, connect with central research centres, share information, and implement ideas more quickly. By linking global resources and easing knowledge transfer challenges, R&D becomes more accessible in a "flatter world" (Ahi et al., 2022). The findings were similar to Ahi et al. (2022) in that they demonstrate that digital tools and virtual networks make the world flatter for R&D collaborations, enabling knowledge transfer quicker. Furthermore, Papanastassiou et al. (2020) emphasised that digital technologies enable virtual collaborative environments regardless of distance, particularly when transferring and processing codified knowledge. The finding were similar to the views presented by Papanastassiou et al. (2020). Moreover, the findings were similar to Dachs et al. (2024) who highlighted that the adoption of digital technologies for prototyping has strengthened the perception of a technology-driven acceleration in research and development (R&D) and innovation. The findings demonstrated that indeed virtual technologies may be used for prototyping to strengthen R&D and innovation.

The findings show that digital tools now allow organisations to automate routine reporting and record equipment downtimes. These tasks used to require human involvement, but reports can now be shared instantly without delays across the entire organisation. These findings are similar to the view of Furr et al. (2022) who highlighted that digital tools enhance R&D efficiency by automating rule-based execution and repeated operational tasks. The findings are different to this literature as they focus on the operational efficiency, while Furr et al. (2022) referred to R&D efficiency. However, these findings are similar views by Mubarak and Petraite (2020) who emphasised that by automating and

digitising manufacturing and operational processes, MNEs achieve greater productivity and enhanced innovation performance.

The findings revealed that virtual networks enabled MNEs to innovate faster, reducing time for product development, thus reducing time to market. These findings are similar to those by Dahms et al. (2020) who emphasised that innovation collaborations enable speeding up time-to-market of new product launches. Additionally, the findings have similarities with Froese et al. (2025), who suggested that the use digital technologies increase innovation agility, particularly in areas such as in product development.

6.4.2.2. Conclusion of theme

The findings were similar to the literature presented; with one nuanced difference that was found. The findings were similar to Ahi et al. (2022) and Papanastassiou et al. (2020), who both argued that digital technologies create a "flatter world" for R&D by enabling rapid knowledge transfer and seamless virtual collaboration. The findings were also similar to Dachs et al. (2024), highlighting how digital prototyping tools accelerate innovation cycles and support technology-driven advancements in R&D. Similar to Dahms et al. (2020) and Froese et al. (2025), these findings show that innovation collaborations accelerate product launches, and digital technologies enhance agility in product development.

The nuances of difference of the findings with these scholars is that the findings highlighted the reduction of product development time when using virtual networks or digital tools, but the literature does not.

6.4.3. Theme 3: virtual networks as enabler of customer driven innovation

6.4.3.1. Update of literature on virtual networks as enabler of customer driven innovation

The author identified the theme of "virtual networks as enabler of customer driven innovation" as a new theme, hence there was no literature on this theme and subthemes in the chapter 2. This necessitated a literature update on the topic. Hence, the author performed the literature search as described in steps in paragraph 6.1. Similar steps were followed for "customer service improvement", "omnichannel experience", "customer self service capabilities".

Step 1 was followed by searching and yielded no results in the author's current articles used for literature survey.

Table 36: Scholarly articles reviewed

Authors	Article title	Journal of Publication
Volberda, H.W., Khanagha, S., Baden-Fuller C., Mihalache, O. R., & Birkinshaw, J.	Strategizing in a digital world: Overcoming cognitive barriers reconfiguring routines and introducing new organisational forms	*Long Range Planning (2021)*
Furr, N., Ozcan, P., Eisenhardt, K.M.	What is digital transformation? Core tensions facing established companies on the global stage	*Global Strategy Journal (2022)*
Fleury, A., Fleury, M., T. L., Oliveira, L., & Leao, P.	Going digital EMNEs: The role of digital maturity capability	*International Business Review (2024)*

No literature was found on “virtual networks as enabler of customer driven innovation” , however some literature on the concepts related to the details of the findings were found and listed as updates to literature review. Therefore, step 2 was followed for “virtual networks as enabler of customer driven innovation”.

Step 2: A Google Scholar search for top three authors was conducted to review their scholarly articles which may have information about virtual experimental environments, Mudami Ram, Furr Alan, and Tallman, Stephen, in the field of digital technologies and international business.

No results yielded.

Step 3: A Google search was done for the following words for scholarly articles published in the past five years, within the international business (IB) or digital technologies domains. Searched for the following words: “Virtual networks as enabler of customer driven innovation” “customer driven innovation” “virtual networks and customer service” “Customer self-help capabilities” “customer omnichannel experience”

No literature was found to use the theme “virtual networks as enabler of customer driven innovation”, within the top journals in the IB and digital technology domains.

Digital transformation focuses on updating organizations to meet the needs of new customers, emphasizing transformational leadership, committed management, and an innovative, customer driven culture (Volberda et al., 2021).

Digital tools enable organisations develop products to fit the needs of existing and potential customers (Furr et al., 2022).

Leveraging opportunities presented by digital technologies required an organisation to shift from market-push and internal innovation to greater collaboration and value co-creation with customers, partners, competitors, and other ecosystem members (Volberda et al., 2021).

6.4.3.2. Discussion of virtual *Networks as enabler of customer driven Innovation*

The findings revealed that organisations deploy digital technologies and virtual networks to improve customer service. In some organisations virtual networks and digital technologies are used to give customers the capabilities to self-service or self-help. Virtual networks create an omnichannel experience throughout the entire organisation, where customers have the same experience regardless of where they are. No literature was found on digital technologies or virtual networks improving customer service or customer self service capabilities. Further, no literature was found on virtual networks being used to create omnichannel experiences for customers.

The findings revealed that virtual networks allow organisations to meet the requirements of clients as quickly and less costly as possible. This is for organisations that are moving from being product centric to being customer centric. The findings are similar to Furr et al. (2022) who highlighted that digital tools help organisations develop products to fit the needs of existing and potential customers. Furthermore, the findings revealed that organisations are moving from being product centric to being customer centric, which is similar to Volberda et al. (2021) who argued that digital transformation focuses on updating organizations to meet the needs of new customers, emphasizing transformational leadership, committed management, and an innovative, customer driven culture.

The findings indicated that virtual ecosystems and networks allow organisations to involve customers in solution development, collaboration, and co-creation during the testing of minimum viable products. These findings highlight co-creation with customers, presents similar views to Vuchkovski et al. (2023) who noted that digital technologies pushed the organisation to shift from market push to greater collaboration and value co-creation with customers, partners, competitors, and other ecosystem members.

No literature was found for the theme “virtual networks as enabler of customer driven innovation”, therefore this was seen as a potential new insight from this study. The author

had considered this as a new theme; therefore, they will keep the theme highlighted as new.

6.4.3.3. Conclusion of theme

There were similarities found between the findings and the literature. The findings were similar to Furr et al. (2022), who argued that digital tools enhance the organisation's ability to create offerings to customer requirements, and with Volberda et al. (2021), who highlight that digital technologies fosters customer driven culture in organisational. Furthermore, similarities existed between the findings Vuchkovski et al. (2023) on digital enabled value co-creation with customers.

The differences found lied firstly in the theme "virtual networks as enabler of customer driven innovation". Furthermore , within the theme itself there was not literature found on how virtual networks impact customer service, customer self-help capabilities, and creation of omnichannel experiences for customers. There was no literature found in top scholarly articles within the IB and digital technologies domains. The absence of literature positions these findings as potential new insight. The conceptual framework was updated reflecting this insight.

6.4.4. Conclusion of RQ3

For RQ3, there were similarities between the findings and the extant literature, however there were some nuances of differences found under the themes "driving new business models "and "streamlining R&D processes and costs". An emergent theme was also found to be "virtual networks as enabler of customer driven innovation". Furthermore, there were instances where there was no literature found to support the findings of the study; these were mainly under the theme of "virtual networks as enabler of customer-driven innovation. These were highlighted as potential new insight for the study.

6.5. Chapter summary

Table 37 has been developed to summarise the key similarities and the differences identified between the findings and the literature. This table serves as the conclusion for this chapter.

Table 37: Summary of similarities and differences between findings and literature

Theme	Similarities	Differences
Build a digital architecture and infrastructure	• Composable and modular architecture • Scalable architecture • App developed at subsidiary and rolled out to entire MNE • Dependence on third party app development	• cost reduction – *Pay as you grow, as a driver of using scalable digital architecture*
Crafting digital norms and values	• Building trust • Cultural intelligence • Diversity of inputs in virtual networks or business ecosystems • Psychological safety • Change management	• No difference found
Create virtual experimentation environments	• Use of virtual regulatory sandboxes • Collaborative innovative environments • Use of tacit knowledge for innovative idea generation • Regular experimentation	• Hosting virtual hackathons
Implementing governance mechanisms	• Policies, regulations, standards • Access control and rules • Use of contracts	• No differences found
Develop digital connectivity intelligence	• Centralising innovation initiates through central hubs • Enhance quick data exchange, integration, collaboration, global connectivity • Use of digital tools for MNE's operational activities	• Use of federated networks • Low connectivity areas
Leveraging and orchestrate virtual business ecosystems	• Bring capabilities through partners • Secure partner onboarding	• No differences found

	• *Partner first approach* • Share of wallet or assets • Business ecosystem orchestrator advantage • Alignment and trust • Ecosystems for private and public sectors	
Develop digital big data analytics capabilities	• Data access and transfer regulatory constraints between countries • Data-driven decision making • Need for internet access	• No difference found
Preparing human resource to operate in digital context	• Hire high skilled tech senior personnel • Emergence of new roles • Skills partnerships in business ecosystems • Use of robotic agents	• Dual tier hire strategy – hire fresh university graduates and highly skilled workers
Driving new business models	• Use of digital technologies for new business streams or market • Adapt to consumer preferences • Move from physical to virtual business models	• Use of new digital marketplace and traditional business model • New onboarded capabilities enabling tapping into new markets and revenue streams
Streamlining R&D processes and reducing costs	• Automation of production operations • Collaborative prototyping • Easy and faster knowledge transfer, and faster information sharing • Faster innovation • Quicker time-to-market	• No differences found
Virtual networks as enabler of customer driven innovation	• Meet customer requirements quickly • Customer collaboration • Customer co-creation • Customer centricity from product centricity	• Virtual networks creating omnichannel customer experience • Virtual networks improving customer service • customer self-help capabilities

The next chapter is the conclusion chapter which concludes the research outcomes.

7. Conclusion

7.1. Introduction

This chapter highlights the conclusions of the research outcomes obtained from chapter 6. The chapter will begin with a presentation of the conclusions derived from the comparative analysis of the research findings corresponding to each research question of this study. The conceptual framework was updated based on the findings from chapter 6; this will be presented in this chapter. Additionally, this chapter will present the research contributions, managerial recommendations, and business implications that arise from the study's conclusions. The limitations to the whole study will be outlined, lastly the chapter will show the recommendations for future research.

This study seeks to explore how digital technologies enhance innovation outcomes through virtual networks for MNEs. The research was carried out within MNEs based in South Africa. Within these MNEs, South Africa may act as either the home country or host country to these multinational enterprises (MNEs). The participants were divided into four clusters, namely: Automotive, Banking, Telecommunication, and Manufacturing.

The study seeks to answer the overall research question which is, “How MNEs develop and manage virtual networks to make best use of digital technologies, thus achieving more innovation outcomes (Du et al., 2023)?” To answer this overall research question, it was divided into three sub questions.

7.2. Principal theoretical conclusions

The research outcomes are organised by research questions. The research outcomes were derived from a comparative analysis, conducted with reference to the extant literature. The discussions will explore both the similarities and differences revealed by this study, aiming to uncover new potential insights or contribute additional knowledge to the current literature.

7.2.1. Research Question 1

RQ1 was ‘how do MNEs develop and manage their virtual networks through digital technologies (Du et al., 2023; Zeng et al., 2023)?‘ The objective of this research question was to understand how MNEs develop and manage virtual networks’ research outcomes presented five themes for RQ1, these themes were build a digital architecture and infrastructure, crafting digital norms and values, create virtual experimentation environments, implementing governance mechanisms, and develop digital connectivity.

7.2.1.1. Similarities in RQ1

For the theme of 'build digital infrastructure and infrastructure' the research outcomes were consistent with the literature. The research outcomes were consistent with the literature, particularly in the integration of global standards with modular frameworks that enable adaptability (Zeng et al., 2023) and support fast global expansion (Luo, 2022a). In this way the digital architecture does not become a barrier to future innovation, and when one partner is removed, the system does not collapse. The research outcomes were also consistent in the literature, where these highlighted that digital infrastructure must be support interoperability, integration, extension, or scalability (Luo & Zahra, 2023). Further, the research outcomes were confirmed the literature on leveraging expertise from subsidiaries especially on the app development. MNEs take advantage of cross-cultural programming expertise (Cahen & Borini, 2020) by developing apps in one country and deploying in another country, without having to rebuild for every new local market (Grimpe et al., 2023). Additionally on app development, the research outcomes confirmed that some MNEs depend on third parties for building apps, especially through open software platforms (Luo, 2022a).

For the theme of 'crafting digital norms and values', the research outcomes were consistent with the literature. The research outcomes are particularly consistent with the need for cultural intelligence (Froese et al., 2025) and trust (Hung et al., 2021) when leading virtual teams. Furthermore, the research outcomes confirmed that physical presence is one of the ways of creating long lasting trustworthy relationships when dealing with virtual networks (Galkina et al., 2023). The physical presence may be achieved by visiting the different countries from time and again, to gather information about cultural contexts about other virtual team members (Froese et al., 2025). The research outcomes also confirmed that cultural diversity and heterogeneity, in terms of cultural backgrounds and perspectives, are success factors for virtual networks like business ecosystems (Cha, 2020). The research outcomes were consistent with literature, particularly, the need for leaders to create psychological safety within virtual teams (Froese et al., 2025) , where there is inclusivity, failure is regarded as team outcome (Hung et al., 2021) since the employees are allowed to fail and learn from their mistakes. Further, the research outcomes related psychological safety to understanding the employee' language of appreciation. The research outcomes were consistent with the need for change management for "going digital MNEs" (Bhandari et al., 2023; Vuchkovski et al., 2023) since there is a need for *shifting the way of working* when going through digital transformation.

The research outcomes under the theme ‘create virtual experimentation environment’ had some consistencies with the literature. The research outcomes confirmed that digital technologies enable sharing and exchange of tacit knowledge across subsidiaries (Autio et al., 2021). The use of virtual experimentation environments allows an exchange of tacit knowledge through the collaboration with different team members, especially in virtual hackathons. Furthermore, the findings confirmed that regular experimentation encourages unique capabilities that support knowledge sharing and integration among subsidiaries, strengthening knowledge building processes(Teece, 2025). Additionally, The research outcomes confirmed that regulatory virtual sandboxes bring people across borders in a protected environment to collaborate on innovations, encouraging social exchange (Alaassar et al., 2020).These regulatory virtual sandboxes take place under ‘relaxed’ environments, which meant that the participants are granted temporary exemptions, enabling them to test solutions within regulatory guidelines (Alaassar et al., 2020).

Under the theme of ‘implementing governance mechanisms’, the research outcomes are consistent with the literature. The findings were consistent particularly with the need for carefully crafted mechanisms (Ahi et al., 2022) like contracts, access control, and control rules for use of digital technologies (Meyer et al., 2023). The research showed that information policies are needed between host and home countries, as well as with foreign ecosystems, to address digital risks related to data processing in virtual networks (Luo, 2022a).

Lastly, under theme ‘develop digital connectivity’ the research outcomes were consistent with the literature. The research outcomes confirmed that success of digital transformation depends on creating a centralised system and solid infrastructure (Vuchkovski et al., 2023). The research outcomes were consistent with literature on centralising and standardising routine activities across subsidiaries to increase overall efficiency (Zeng et al., 2023). Furthermore, centralising using hubs or frontline subsidiaries helps with accessibility to decision making power leveraging diverse local contexts (Benito et al., 2022). These frontline subsidiaries or central hubs have distinct mandates and local context specific strategic objective (Luo, 2021) .

The research outcomes confirmed that virtual networks and digital connectivity enhance intra organisational collaboration, sharing, easy learning, productivity and efficiency (Luo, 2021). The research outcomes confirmed that digital connectivity encompasses

integration of digital technologies into al functions and locations of MNEs, generating intelligence that fosters continuous innovation and flat decisions making (Luo, 2022b).

7.2.1.2. Differences in RQ1

The research outcomes presented a nuanced difference in the driving force behind the use of scalable digital architecture. The research outcomes emphasised that the architecture must be scalable to reduce costs and pay as you grow, while the literature motivates scalability to enable coordination and control by small headquarters (Autio et al., 2021).

The theme ‘create virtual experimentation environment’ was highlighted as a potentially new insight since the theme was not found in the literature. The research outcomes revealed that MNEs must create virtual experimentation environments where employees are allowed to freely experiment, stimulating innovation. The research outcomes suggested that MNEs host virtual hackathons, across their global regions, to encourage cross functional collaborative and promote innovation through solving complex business challenges. Another nuance of difference was found in the study is that empirical evidence describes innovation as an outcome, but literature describes stronger knowledge building processes as an outcome.

The research outcomes presented a nuanced difference with literature on the use of federated networks. The use of federated networks allows for subsidiary autonomy, with central coordination from headquarters, avoiding one single point of failure, creating a balance between control and autonomy.

The research outcomes revealed a nuance of difference with literature in digital connectivity for MNEs ’going digital’ where they have subsidiaries (host countries) in areas of no connectivity (network access). These MNEs would first need to invest in connectivity infrastructure before transforming digitally, highlighting that the digital transformation is not as seamless. This is a challenge that MNEs face in the different areas of the world.

In conclusion, four themes answering research question 1 already existed in literature, with some nuances of difference at subtheme level. One theme, create virtual experimentation environment, was not found in the extant literature as one of the processes of developing virtual networks enhancing innovation outcomes. At subtheme level there were some nuances of differences identified, however even similarities with literature existed. Based on the empirical evidence presented in this study, the

differences identified at theme level, were considered to provide new insight which have a theoretical contribution of refinement to existing body of knowledge (Crane et al., 2016). The similarities identified in the outcomes are add to the existing body of knowledge.

7.2.2. Research question 2

RQ2 was 'how do MNEs enhance their capabilities to harness use of digital technologies in virtual networks (Fleury et al., 2024)?' The research outcomes presented three themes for tis research questions, namely: leveraging and orchestrate virtual business ecosystems, develop big data analytics capabilities, and preparing human resource to operate in a digital context.

7.2.2.1. Similarities for RQ2

In the theme 'leveraging and orchestrate virtual business ecosystems' the research outcomes were consistent with the extant literature. The research outcomes confirmed that organisations cannot deliver goods or services on their own, and therefore shift certain costs and activities to partners, complementors, customers, and other stakeholders at home or abroad (Meyer et al., 2023). Furthermore, the research outcomes confirmed literature, that virtual partnerships enable organisations to share digital assets and share sales(wallet) making it quicker to attract and reach out to customers (Cahen & Borini, 2020). These are achieved by accessing capabilities that may have not been available to the organisation (Furr et al., 2022). The research outcomes were consistent with literature, particularly about multilateral alignment (Mubarak & Petraite, 2020) and trust being important in virtual business ecosystems (Spaniol & Rowland, 2022). Digital trust strengthens open innovation performance and competitiveness of globally networked MNEs (Mubarak & Petraite, 2020).

The research outcomes were confirmed literature that the virtual ecosystem orchestrator defines the relevant ecosystem architecture and decides on partner onboarding (Benito et al., 2022; Furr et al., 2022). The research outcomes further were consistent with existing literature on the partner first approach, in which all virtual ecosystem partners are equal, presenting a decentralised authority (Cha, 2020). The research outcomes were consistent with extant literature, showing that virtual business ecosystems consist of both government and private sector participants (Cha, 2020), who collaborate to address societal or governmental issues as well as other common goals.

For the ‘develop digital data analytics capabilities’ theme, research outcomes were consistent with existing literature, highlighting that data is regulated. MNEs must establish country specific virtual ecosystems that can protect transfer of data in compliance with local or host country regulations (Furr et al., 2022). The research outcomes confirmed the extant literature that digital connectivity relies on digital platforms, ICT, intern and intranet access as well as technologies like big data, cloud services, and data analytics (Luo, 2022a).

Further the research outcomes were consistent with extant literature particularly with the production of data which is used to derive predictive insights that support decision making (Mubarak & Petraite, 2020). Further, digital tools can be used to improve real-time decisions by efficient data capturing, storage, and generating intelligences (Ahi et al., 2022; Luo, 2022b). The research results supported previous studies by showing that drones can be used to gather data to inform investment decision making. This demonstrates that using data-driven decision making within global value chains enables multinational enterprises to stay competitive (Fleury et al., 2024).

For the theme ‘preparing human resource for digital context’, the research outcomes are consistent with the literature. The research outcomes confirmed that there are new roles that emerge during digital transformation (Vuchkovski et al., 2023). The research outcomes are consistent with the literature on the attracting, recruiting, developing, and motivating highly skilled workers to solve complex problems (Fleury et al., 2024). The search outcomes further confirmed that for superior innovation performance, organisation require IT advancement, competencies, and strong external and internal networks (Dahms et al., 2020).

Furthermore, the research outcomes were consistent with extant literature about partnering with subject matter experts, through digital connectivity, in areas of internal skill deficiency (Luo, 2021). This is confirmed further by Froese et al. (2025), that digital virtual ecosystems are used for distributed talent orchestration, where expertise is accessed and activated across geographies without physical relocation. Finally, the research outcomes are consistent with literature about using robotic agents for tasks traditionally done by humans; these robots operate autonomously, show greater adaptability, collaborate well, and handle complex tasks efficiently.

7.2.2.2. Differences for RQ2

A nuance of difference was found under the theme 'preparing human resource for digital context'. This was with regards to the way the organisation recruits their IT skills, using a dual tier strategy. This organisation recruit highly skilled, experienced workers, and fresh university graduates who will be upskilled. The fresh university graduates were recruited due to their enthusiasm for learning, fresh perspectives they bring, and exposure to the latest digital technology tools.

In conclusion only one nuance of difference was found under RQ 2, and the rest of the other subthemes were consistent with expositing literature. Based on the empirical evidence presented in this study, the differences identified at theme level, were considered to provide new insight which have a theoretical contribution of refinement to existing body of knowledge (Crane et al., 2016). The similarities identified in the outcomes are add to the existing body of knowledge.

7.2.3. Research question 3

RQ3 was 'how do MNEs' virtual networks and digital technologies enhance innovation outcomes (Benito et al., 2022; Du et al., 2023)?' The research outcomes presented three themes for this research question. The themes were driving new business models, streamlining R&D processes and reducing costs, virtual networks as enabler of customer driven innovation.

7.2.3.1. Similarities in RQ3

The research outcomes confirm existing literature on virtual ecosystem innovation, showing that organizations access wider markets and collaborate more effectively with customers and across regions (Zeng et al., 2023). Further to this, the use of digital technologies provides new opportunities for customer engagement, new revenue generation, access to new markets, and adaptation to changing consumer preferences (Bhandari et al., 2023; Zahra & Mudambi, 2025). The research outcomes confirmed the literature by demonstrating that traditional MNEs need to redesign their legacy structures to support agile new business models (Volberda et al., 2021). A traditional MNE explored the use of a virtual marketplace to reach out to a different segment of their customers. The research outcomes demonstrate that digital transformation helps organizations access information to create new business models and tap into emerging markets. Digital technologies drive innovation and value creation across global networks (Bouncken et

al., 2023; Furr et al., 2022). This was demonstrated through banks that shift from the use of physical branches to virtual branches and banks adopting fintech models.

The research outcomes support literature by demonstrating that the use of digital technologies and virtual networks make the world flatter for R&D collaborations, enabling seamless knowledge transfer (Ahi et al., 2022). Furthermore, the research outcomes are consistent with extant literature in that digital technologies facilitate virtual collaborative environments capable of supporting efficient transfer and processing of codified knowledge regardless of physical distance (Papanastassiou et al., 2020). The outcomes confirmed the extant literature by demonstrating that indeed virtual technologies may be used for prototyping to strengthen R&D and innovation (Dachs et al., 2024). The research outcomes confirmed the literature that automating and digitising manufacturing and operational process, MNEs achieve greater productivity and enhance innovation performance (Mubarak & Petraite, 2020). The research outcomes were consistent with literature that innovation collaborations speed up time to market of new products (Dahms et al., 2020) and increases agility in product development.

Research outcomes confirmed the literature showing that organisations shifted from product centric to customer centric models, adopting transformational leadership, committed management, and an innovative, customer driven culture to meet evolving customer needs (Volberda et al., 2021).

The research outcomes were consistent with literature that digital technologies have enabled organisations to shift from market push to more collaboration and value co-creation with customers, partners, competitions, and other members of the ecosystem (Vuchkovski et al., 2023).

7.2.3.2. Differences in RQ3

The nuance of difference was identified from the research outcomes under the theme of ‘driving new business models. This nuance of difference was that a traditional MNEs explored a different route to market strategy by using virtual marketplace to research out to their end user market. This MNE still kept their traditional business model and added the digital marketplace business model to it. This demonstrates that MNEs going digital do not have to completely abandon their traditional business model and fully adopt digital technologies. The two business models may coexist.

Another nuance of difference identified in the research outcomes was that the onboarded capabilities derived from virtual business ecosystems enable tapping into new markets.

Extant literature often referred to the use of digital tools enabling development new revenue streams and new markets (Zahra & Mudambi, 2025), which is different from what was revealed from the research outcomes.

A nuance of difference was found at theme level ‘virtual networks as enablers of customer driven innovation”. The theme was not found in the literature in the domains of digital technologies and international business. The theme may exist under marketing but does not entail virtual networks. This was highlighted as a potentially new insight and refinement to existing body of literature.

The research outcomes presented nuances of differences under the theme of ‘virtual networks as enables of customer driven innovation’. The research outcomes highlighted that virtual networks create omnichannel experiences thought the MNE, where customer have the same experience regardless of where they geographically are. Further, the research outcomes showed that digital technologies or virtual networks improve customer service of customer self service capabilities. These nuances of differences were potential new insight that will refine the existing body of knowledge.

In conclusion, RQ3 themes presented similarities and nuances of differences. Most of the nuances of differences came from the theme ‘virtual networks as enablers of customer driven innovation’. The theme itself was considered as a potential refinement to the existing body of knowledge. This is based on the empirical evidence presented in this specific study.

7.2.4. *Final Conceptual framework*

The conceptual framework showing how digital technologies enhance innovation outcomes through virtual networks of MNEs, has been updated based on the conclusions from this study. This summarises key consideration of how MNEs develop and manage virtual networks, enhance their capabilities to harness digital technologies, and how this enhances their innovation outcomes.

The conceptual framework highlighted the similarities and difference between the research outcomes and extant literature. The similarities are written in black, while the differences are written in yellow font.

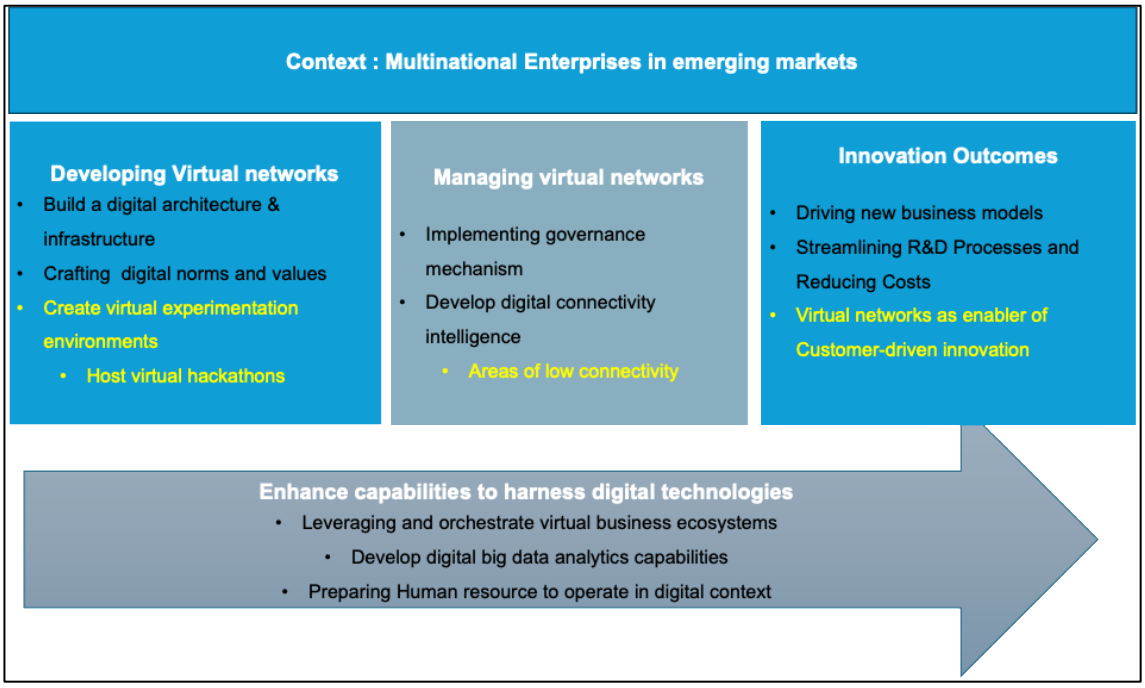


Figure 4: Final conceptual Framework (authors own)

Not all the potential new insights at subtheme level were included in the conceptual framework. The nuances of difference were added in the prior sections of this chapter. Only the similarities and subthemes were included in the conceptual framework.

7.3. Research contribution

The aim of the study was to explore how digital technologies enhance innovation outcomes through virtual networks of MNEs. The author investigated how MNEs develop and manage their virtual networks, and how MNEs can build capabilities to harness the use of their digital technologies. Lastly investigated how virtual networks enhance innovation outcomes, enabled by digital technologies. Thorough a comparative analysis between the research outcomes and the extant literature, the similarities identified could potentially be additions to the existing body of knowledge. Furthermore, the differences identified contributes as potential new insight that could be refinement and adaptation to the existing body of knowledge. Crane et al. (2016) suggested that studies based on different countries have a theoretical contribution of refinement and adaptation of existing theories, because the constructs have been developed in other in other economies.

7.3.1. Additions to existing body of knowledge

Based on the work conducted in this study, the similarities identified add insight to the existing body of literature. The setting, scope, and context this study may not particularly

be same as previous studies, however the similarities identified add to the existing body of knowledge since some of the empirical evidence confirms the extant literature. There were similarities found in the outcomes for most of the themes. The Table 38 shows the research contributions based on this study.

Table 38: Potential additions to extant literature

Research Question	Theme	Subtheme
How do MNEs develop and manage their virtual networks through digital technologies?	*Build a digital architecture and infrastructure*	• Composable, modular, and scalable digital architecture which removes innovation barriers for the future • App developed at subsidiary and rolled out to entire MNE organisation • Use of third-party app developer through virtual business ecosystem
	Crafting digital norms and values	• Building trust by creating personal connections • Have cultural intelligence to deal with different virtual team participant from different settings • Diversity of inputs in virtual networks or business virtual ecosystems • Create psychological safety for virtual team members, where members are allowed to fail • Change management – shifting the way of work
	Create virtual experimentation environments	• Use of virtual regulatory sandboxes • Collaborative innovative environments allow for knowledge transfer and improve innovation outcomes • Use of tacit knowledge for innovative idea generation • Regular experimentation encourages unique capabilities supporting knowledge sharing
	Implementing governance mechanisms	• Use of policies, regulations, standards • Access control and rules • Use of contracts
	Develop digital connectivity intelligence	• Centralising innovation initiates through central hubs

		• Virtual networks enhance quick data exchange, integration, collaboration, global connectivity • Standardise of digital tools for MNE's operational activities
How do MNEs enhance their capabilities to harness use of digital technologies in virtual networks?	*Leveraging and orchestrate virtual business ecosystems*	• Bring capabilities through partners • Secure partner onboarding • *Partner first approach* – equal • Share of wallet or assets • Business ecosystem orchestrator advantage • Alignment and trust within virtual business ecosystems • Ecosystems for private and public sectors
	Develop digital big data analytics capabilities	• Manage data access and transfer regulatory constraints between countries • Data-driven decision making • Need skills to convert unstructured data into useful insights • Need for internet access for digital transformation
	Preparing human resource to operate in digital context	• Hire high skilled tech senior personnel • Emergence of new roles when 'going digital' • Skills from partnerships in business ecosystems • Use of robotic agents in routine work
How do MNEs' virtual networks and digital technologies enhance innovation outcomes?	*Driving new business models*	• Use of digital technologies for new business streams or market • Adapt to consumer preferences • Move from physical to virtual business models
	Streamlining R&D processes and reducing costs	• Automation of production operations • Collaborative prototyping • Easy and faster knowledge transfer, and faster information sharing • Faster innovation • Quicker time-to-market
	Virtual networks as enabler of customer driven innovation	• Meet customer requirements quickly • Customer collaboration • Customer co-creation • Customer centricity from product centricity

7.3.2. Refinement to existing body of knowledge

Based on the work conducted in this study, some nuances of differences were identified, the author identified these as potential refinement to existing body of knowledge. Table 39 shows the potential refinements of this study.

Table 39: Potential refinements to extant literature

Research Question	Theme	Subtheme
How do MNEs develop and manage their virtual networks through digital technologies?	*Build a digital architecture and infrastructure*	• cost reduction – *Pay as you grow,* as a driver of using scalable digital architecture
	Create virtual experimentation environments	• Hosting virtual hackathons as processes for innovation and knowledge transfer
	Develop digital connectivity intelligence	• Use of federated networks balancing autonomy of subsidiaries and control by headquarters • Digital transformation in areas of low connectivity
How do MNEs enhance their capabilities to harness use of digital technologies in virtual networks?	*Preparing human resource to operate in digital context*	• Dual tier hire strategy – hire fresh university graduates and highly skilled workers as part increasing digital capabilities
How do MNEs' virtual networks and digital technologies enhance innovation outcomes?	*Driving new business models*	• Use of new digital marketplace and traditional business model • New onboarded capabilities enabling tapping into new markets and revenue streams
	Virtual networks as enabler of customer driven innovation	• Virtual networks creating omnichannel customer experience • Virtual networks improving customer service • customer self-help capabilities

7.4. Recommendations for management

Based on the work conducted in this study, the following are recommendations to management using digital technologies and virtual networks and wish to enhance innovation outcomes in their organisations.

- MNE virtual team leaders can create an environment that allows for inclusivity and psychological safety of employees who are involved in virtual networks.
- MNEs can host virtual hackathons in which they allow collaborative, and innovative problem solving for complex challenges within the MNEs.
- MNEs can adopt federated architectures. In this way, MNEs can improve their resilience, reduce dependency on single systems, and enhance local responsiveness. The use of federated networks also allows headquarters to maintain oversight while subsidiaries maintain autonomy to innovate and respond to local market specific needs. This creates foreign subsidiary advantages.
- MNEs may establish specialised hubs for R&D, digital maintenance, and innovation to streamline global operations.
- Formalise partner onboarding by defining ecosystem roles, responsibilities, and expected upfront contributions. Build partner first digital ecosystems, strengthen digital trust, formalise architecture.
- Complement recruitment with fresh university graduates who bringing from perspectives, digital enthusiasm, and exposure to the latest technologies.
- Managers must embrace the coexistence of traditional and digital business models. This will allow organisations to reach new customer markets without disrupting the existing profitable channels.
- Develop an omnichannel experience that standardises the virtual customer journey in all markets. Use virtual networks to strengthen customer driven innovation through value cocreation.

7.5. Limitations of the study

The limitations of the methodology used in this study are described in Chapter 4, paragraph 4.16 of the methodology section. The limitations discussed here refer to the study as a whole and are follows:

- This study was conducted only in South Africa and does not explore other geographical contexts
- This study did not focus on a specific sector

- This study did not explore in depth, the areas of nuanced difference that were identified

7.6. Suggestions for future research

Since the different sectors present different contexts in terms of digital transformation and the use of virtual networks, future research may focus on one sector and explore more insight from a specific context. Each sector is presented with different scenarios of how they engage in virtual networks and use the virtual business ecosystem, focus on a specific sector would bring rich insight.

This study was conducted in South Africa, which is a developing country and may have different contexts in terms of adoption of digital technologies and virtual networks. Studies on adoption of digital technologies have been conducted in Europe and part of Asia. Therefore, it would be interesting for future studies to perform the research based on another developing African country to give more insight on how the MNEs in these countries use virtual networks in enhancing innovation outcomes.

The research outcomes presented some nuances of differences that the author did not explore. Future studies may explore these, for example future research may explore the effectiveness of using hackathons as innovative processes. They may explore how the virtual network dynamics of cross team collaboration impact the innovation outcomes derived from these virtual hackathons.

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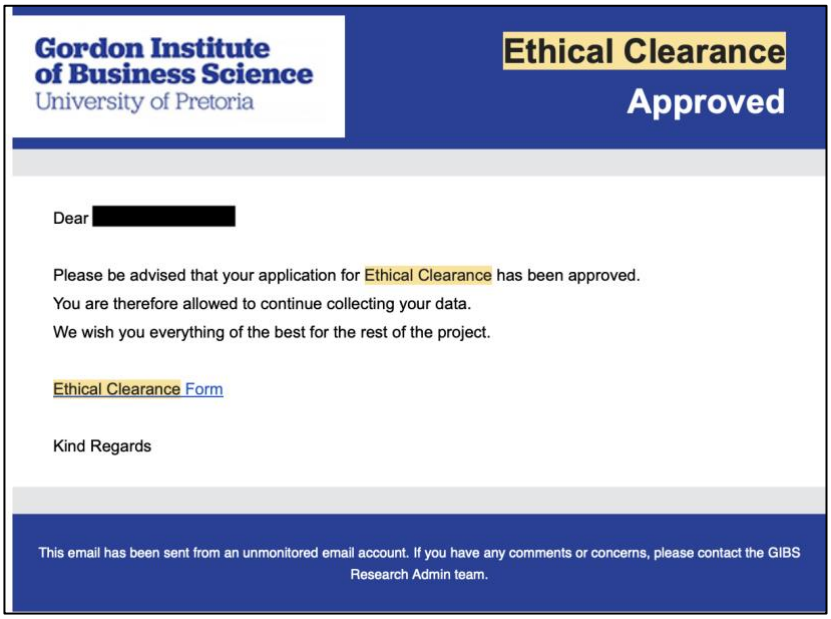
9. Appendices

A1. Ethical clearance approval



Gordon Institute of Business Science
University of Pretoria

Ethical Clearance Approved

Dear [redacted]

Please be advised that your application for Ethical Clearance has been approved.
You are therefore allowed to continue collecting your data.
We wish you everything of the best for the rest of the project.

Ethical Clearance Form

Kind Regards

This email has been sent from an unmonitored email account. If you have any comments or concerns, please contact the GIBS Research Admin team.

A2. Copy of consent form

Informed consent for interviews

> ***Note:*** *This standard informed consent letter to be used in qualitative interviews, must be separate from interview guide, must be signed before the interview commences. The signed form must be stored separately from the data collected*

I am conducting research on "*How digital technologies enhance innovation outcomes through virtual networks in MNEs*" . Our interview is expected to last *45 to 60 minute*, and will help us understand how digital technologies impact innovation, through virtual networks for MNEs. **Your participation is voluntary and you can withdraw at any time without penalty**. By signing this letter, you are indicating that you have given permission for:

- The interview to be recorded;
- Verbatim quotations from the interview may be used in the report, provided they are not identified with your name or that of your organisation;
- The data to be used as part of a report that will be publicly available once the examination process has been completed; and
- All data to be reported and stored without identifiers.

If you have any concerns, please contact my supervisor or me. Our details are provided below.

Researcher name: Research Supervisor name:

Email: 24126162@mygibs.co.za Email:

Phone : Phone:

Signature of participant: _____

Date: _____

Signature of researcher: _____

Date: _

A3. Consistency matrix

Title: Harnessing digital technologies to enhance innovation outcomes through virtual network in MNEs

Research Question	Focus area	Contribution to main RQ	References
RQ: How MNEs develop and manage virtual networks to make best use of digital technologies, thus achieving more innovation outcomes? (Du et al., 2023)			
RQ1: How do MNEs develop and manage their virtual networks through digital technologies?	Development and management	Explores the development and management of virtual networks in collaboration	Hung et al. (2021)
RQ2: How do MNEs enhance their capabilities and harness digital technologies when managing their virtual networks?	Digital enablement	Explores how MNES develop capabilities to harness the use of digital technologies	Dahms et al. (2025) Fleury et al. (2024) Teece (2025)
RQ3: How do virtual networks that use digital technologies enhance innovation outcomes in MNEs?	Desired outcome	Explores how the MNEs virtual networks and the use of digital technologies impact innovation outcomes	Dahms et al. (2020) Benito et al. (2022)

A4. Interview guide

Section	Interview Question	Aimed outcomes	Literature
A: Set the scene	1.May you please describe your roles and responsibilities within your organisation?	Identify role of participant	Du et al. (2023)
B: MNEs virtual networks	2. Please tell me about your experience on how your organisation develops virtual networks (internal and external)? 3. Please may tell me about your understanding of how your organisation manages these networks? 4. Please could you tell me about your experience of how the relationships within the virtual networks evolve over time? 5. Please could you tell me about the anticipated deliverables from your organisations' interactions with their virtual networks?	Identify how virtual networks are developed and managed	Hung et al. (2021)
C: Digital technologies	6. Please could you tell me about your experience of how your organisation built internal digital capabilities to support the interaction with their virtual networks? 7. Please could you tell me about your experience of how the organisation developed or sourced digital technology skills or expertise to support virtual network management? 8. Please tell me about your understanding of the key factors essential for effective utilisation of digital technologies within your organisations' virtual networks?	Identify capabilities and the use of digital technologies	Dahms et al. (2025) Fleury et al. (2024) Teece (2025)
D: Innovation outcomes	9. Please could you tell me about your understanding of the innovation outcomes that the organisation expects from deploying digital technologies and virtual networks. 10. In your knowledge, what makes a virtual network successful in driving innovation and what role does digital technologies play in that success?	Identify if desired goal has been met	Dahms et al. (2020) Benito et al. (2022)
E: Reflection	11. How would you advise people using digital technologies to enhance innovation through virtual networks?	Wrap up to answer overall research question	Du et al. (2023)

A5. Atlas.ti Codes

#	**1st order codes**	**1st categories**	***Theoretical themes***	**Construct**
1	○ virtual network	adaptive digital architecture	*Build a global digital architecture & infrastructure*	Developing virtual networks
2	○ access control	Invest in Cloud-based platforms		
3	○ access to resources	Development of Applications		
4	○ accessibility	virtual collaborative networks		
5	○ accountability for Uptime	cultural intelligence and adaptability	*crafting digital norms & values*	
6	○ adjacent innovation spin-offs	Advocate leadership sponsorship		
7	○ innovation labs	Bet on People		
8	○ agent deployment	camera comfort and use during virtual meetings		
9	○ agile co-creation	allow employees to fail		
10	○ agility	Provide employees psychological safety in virtual teams		
11	○ agreed partner expectations	invest in change management process		
12	○ allow employee creativity	breaking silos		
13	○ allow employees to fail	Host virtual hackathons as participative innovation drives	*Create virtual experimentation environments*	
14	○ API integration	Use virtual sandboxes as experiment safe spaces		
15	○ app startup companies	create virtual Innovation hubs		
16	○ Applications	develop Innovation organisational mindset		
17	○ architectural compliance guides	Create innovation labs		
18	○ artificial intelligence	develop a centralised intelligence integration	*Developing digital connectivity intelligence*	Managing virtual networks
19	○ virtual reality collaboration	needs basis analysis for digital tools		
20	○ autonomy	Avoid digital organisational isolation risk		
21	○ AWS cloud base	global network integration		
22	○ bet on people	Enable real time collaborative design		
23	○ big data driven strategy formulation	introduction of virtual reality collaboration		

24	○ break communication barriers	Promote use federated cloud infrastructure		
25	○ break physical geography barriers	Digital agent deployment for network coordination		
26	○ breaking silos	Artificial intelligence &automation enablement		
27	○ bridge geographical barriers	create virtual Innovation hubs		
28	○ build platforms of advantage	Enable Information access and sharing		
29	○ buy-in	Maintain Transparency	*Implement governance mechanisms*	
30	○ camera comfort and participation	Digital agent deployment for network coordination		
31	○ capability assessment	ensure digital data privacy		
32	○ capability complement	Implementation of contractual digital relationships		
33	○ capability sourcing	Integration Risk Awareness		
34	○ capability gap recognition	Implement governance and security standards		
35	○ capital expenditure for digital tools	architectural compliance guides		
36	○ care for employees	define clear roles and responsibilities		
37	○ cater for capacity	virtual proof of concept	•*Leveraging & orchestrate virtual ecosystem*	Enhance digital capabilities to harness digital technologies
38	○ centralised intelligence integration	virtual prototype evaluation		
39	○ challenges in information access	capability gap recognition & assessment		
40	○ change management	Can onboard new partners at any stage of project		
41	○ cheaper	External Capability & skills sourcing		
42	○ cheaper cloud-based networks	Agile co-creation		
43	○ choosing the right skills	Trust in Partnerships		
44	○ clear roles and responsibilities	collaborative solution design		
45	○ cloud base support	Pay-as-you use model		
46	○ Cloud based	distributed software development		
47	○ Cloud based network	Digital capability development		
48	○ cloud consolidation strategy	equitable partner engagement		

49	○ cloud ecosystem efficiency	Shared KPIs		
50	○ cloud infrastructure	Shared Capabilities & assets		
51	○ cloud integration	Leverage subject matter experts		
52	○ Cloud migration	Shared wallet/value		
53	○ Cloud platform maintenance	continuous upskilling of employees	*Preparing Human resource to operate in digital context*	
54	○ Clusters	recruitment drive for suitable digital skills		
55	○ co-value creation	Skill scarcity - competing for skills in the market		
56	○ cohesion	Dual-Tier Talent Strategies		
57	○ collaboration	Workforce Transformation-evolving IT roles		
58	○ collaborative solution design	Choosing the right skills		
59	○ commercial players	daily operational support from virtual teams		
60	○communication technologies	Develop different training programs		
61	○ communication platform	Embed digital tools to translate languages		
62	○ competing for skills in the market	Promote virtual Relationship Formation		
63	○ competition	Implement augmented reality collaboration meetings		
64	○ composable system architecture	enhance Data Analytics capabilities	*Develop big data analytics Capabilities*	
65	○ conflict resolution	Mine the data collaboratively		
66	○ connect people	Data Sovereignty Constraints		
67	○ connectedness	Big Data Strategy Formulation		
68	○ constant change	Building Artificial Intelligence capabilities		
69	○ constant review	Big Data Strategy Formulation		
70	○ continuous alignment	Drones used for data collection		
71	○ continuous improvement	capture value through adjacent spin offs	*Driving new business models*	Innovation outcomes
72	○ continuous upskilling of employees	digital marketplace development		
73	○ contractual relationships	Adopt platform-based business models		
74	○ convenience driven behaviour	exposure to a larger digital market		

75	○ cost	generate new revenue streams		
76	○ cost efficiency	Enhanced digital cross border knowledge exchange	*Streamlining R&D Processes and Reducing Costs*	
77	○ country language barriers	market fit product development		
78	○ covid as an enabler	data driven product development		
79	○ create clarity- why?	Quick and efficient time to market		
80	○ crisis management	quick transfer of information		
81	○ critical skills identification	tacit knowledge loss		
82	○ cross border knowledge exchange	promote data driven product development		
83	○ cross cultural barriers	customer digital transformation journey	*Virtual network as enabler customer driven innovation*	
84	○ cross cultural collaboration sensitivity	digital enabled customer experience		
85	○ cross functional teams	Meet digital consumer expectations		
86	○ cross skill	Transition from product-led to customer driven solution design		
87	○ cultural diversity awareness	self service capabilities driving solutions		
88	○ culture	customer Value co-creation		
89	○ customer centricity	Omnichannel experience for customers		
90	○ customer data			
91	○ customer digital transformation journey		*1st order codes = 374*	
92	○ customer experience		*1st order categories =89*	
93	○ customer facing		*2nd order categories - 11*	
94	○ Customer pain		*constructs -4*	
95	○ customer self service			
96	○ customer service			
97	○ customisation			
98	○ cyber security			
99	○ daily operational support from virtual teams			
100	○ data analytics			
101	○ data informed product development			

102	○ data lakes			
103	○ data leadership			
104	○ data mining			
105	○ data privacy			
106	○ data sovereignty constraints			
107	○ data warehouses			
108	○ decision making			
109	○ decisiveness			
110	○ democratising relationships			
111	○ developer accountability			
112	○ developer growth mindset			
113	○ different platforms dependent on customer			
114	○ differentiation			
115	○ digital capability development			
116	○ digital consumer expectations			
117	○ digital market access limitations			
118	○ digital marketplace			
119	○ digital technologies			
120	○ digital technology adoption			
121	○ digital technology enables sharing			
122	○ digital tool avoidance			
123	○ digital tool lock in contracts			
124	○ digitalisation and virtualisation strategies			
125	○ disaster recovery			
126	○ distributed software development			
127	○ diverse skills			
128	○ dual tier talent strategy			
129	○ due diligence			
130	○ ease of use			
131	○ ecosystem			

132	○ ecosystem agility			
133	○ ecosystem as part of virtual network			
134	○ ecosystem evolution			
135	○ ecosystem orchestration			
136	○ effective management			
137	○ egovernment			
138	○ employee exposure			
139	○ enterprise system Integration			
140	○ equitable partner engagement			
141	○ Evolving IT roles			
142	○ example of virtual network			
143	○ experienced suppliers			
144	○ Experience			
145	○ experiential exposure			
146	○ experiential learning influence			
147	○ exposure to a bigger market			
148	○ exposure driven creativity			
149	○ external app develoment			
150	○ extroversion vs introversion			
151	○ federated architecture			
152	○ feedback loops			
153	○ financial benefits			
154	○ Fintech			
155	○ first mover advantage			
156	○ fit for purpose infrastructure			
157	○ Foresight			
158	○ generate new revenue streams			
159	○ generative AI			
160	○ geographically distributed team			
161	○ geolocation services			

162	○ global connectivity			
163	○ global network integration			
164	○ global organisational awareness			
165	○ governance and security			
166	○ governance standards			
167	○ growth			
168	Host virtual hackathons			
169	○ Head office project initiation			
170	○ high tech skills			
171	○ hire skills externally			
172	○ Home country research centre			
173	○ Human-machine skill co-evolution			
174	○ idea generation			
175	○ idea justification			
176	○ innovation loves challenges			
177	○ in-situ technologies			
178	○ identify industry problems to solve			
179	○ information access and sharing			
180	○ information integrity			
181	○ Infrastructure capabilities			
182	○ infrastructure maintenance			
183	○ infrastructure upgrade			
184	○ inhouse digital platform			
185	○ innovation accelerated by virtual networks			
186	○ innovation ecosystem			
187	○ innovation hub			
188	○ innovation organisational mindset			
189	○ innovation ready architecture			
190	○ instant access culture			

191	○ integration risk awareness			
192	○ interfaces			
193	○ internal app development			
194	○ internal collaboration			
195	○ internal global collaboration			
196	○ internal innovation ecosystems			
197	○ internal network management			
198	○ internal technology enablement			
199	○ internalisation of ecosystem output			
200	○ interoperability			
201	○ Interplay of AI and analytics			
202	○ invest in cutting edge tools			
203	○ invest in industries going "green"			
204	○ Job deliverables			
205	○ job rotation for interns			
206	○ keep it simple			
207	○ leadership sponsorship			
208	○ legacy technologies			
209	○ legacy technology resignation strategy			
210	○ leverage subject matter expertise			
211	○ licence investment vs tool adoption			
212	○ Longevity			
213	○ Long-term relationship evolution			
214	○ low adoption			
215	○ machine learning			
216	○ management alignment			
217	○ manual approach			
218	○ market access			

219	○ market fit product			
220	○ market intelligence research			
221	○ market leadership			
222	○ marketing innovation			
223	○ measurement of success			
224	○ minimum frequency of collaboration			
225	○ minimum viable product			
226	○ modernise technology			
227	○ modular system architecture			
228	○ monetary rewards			
229	○ Monitoring			
230	○ must support experience			
231	○ need to fail fast to correct			
232	○ needs basis analysis			
233	○ network infrastructure			
234	○ new adopter of virtual networks			
235	○ new business model generation			
236	○ nimble			
237	○ no repetitive tasks			
238	○ Orchestrate			
239	○ Omnichannel experience			
240	○ onboard orientation for employees			
241	○ Onboarding new partners			
242	○ online preventative maintenance monitoring system			
243	○ open growth mindset			
244	○ operational efficiencies			
245	○ organisation isolation risk			

246	○ organisation readiness enablement			
247	○ organisational fit			
248	○ organisational innovation hubs			
249	○ organisational strategy alignment			
250	○ outcome driven collaboration			
251	○ outsource digital tools			
252	○ Outsource skills			
253	○ outsource virtual network management			
254	○ Pan African strategy			
255	○ partner trust			
256	○ partner with universities			
257	○ Pay as you grow			
258	○ people leadership			
259	○ performance monitoring			
260	○ personal context awareness			
261	○ physical and virtual collaboration			
262	○ physical troubleshooting			
263	○ platform-based business models			
264	○ platform mindset			
265	○ plug in and play integration			
266	○ predictable systems			
267	○ Proactive engagement			
268	○ proactive management			
269	○ proactivity			
270	○ problem detection			
271	○ product cycle			
272	○ product development			
273	○ proof of concept			
274	○ prototype evaluation			
275	○ psychological safety			

276	○ purpose led organisation			
277	○ quick and efficient time to market			
278	○ quick integration			
279	○ quick transfer of information			
280	○ quick turnaround time for innovative solutions			
281	○ R&D			
282	○ real time collaborative design			
283	○ real-time monitors			
284	○ reflection			
285	○ regional innovation contribution			
286	○ regular software updates			
287	○ Reliability			
288	○ remote access to apps			
289	○ remove geographic distance barriers			
290	○ resistance to change			
291	○ resistance to digital tools			
292	○ response to changes in infrastructure			
293	○ responsiveness			
294	○ return on investment			
295	○ reuse designs			
296	○ Roadmap			
297	○ robotics and virtual networks			
298	○ same design language			
299	○ scalability			
300	○ seamless collaboration			
301	○ secure digital infrastructure			
302	○ security			
303	○ self-paced training			
304	○ service delivery			
305	○ service efficiency			
306	○ share wallet			

307	○ shared capabilities			
308	○ shared expectations			
309	○ Shared KPIs			
310	○ shared model			
311	○ shared value			
312	○ single design center			
313	○ skill availability			
314	○ skill quality			
315	○ skills recruitment drive			
316	○ software development and cloud infrastructure			
317	○ solution validation			
318	○ speed to market			
319	○ speed up process			
320	○ speedy execution			
321	○ speedy response during crises			
322	○ speedy response to market			
323	○ stable infrastructure network			
324	○ standardised virtual networks			
325	○ strategic alignment			
326	○ strategic goals			
327	○ strategic learning orientation			
328	○ strategic partnership formation			
329	○ strong business case			
330	○ strong relationship bonds			
331	○ subsidiary interaction with stakeholders			
332	○ support demand			
333	○ tacit relational knowledge loss			
334	○ Team and project charter			
335	○ team cohesion			
336	○ technical advisory influence			
337	○ technician supervision			

338	○ technological advances			
339	○ technology driven service delivery			
340	○ technology trends			
341	○ technology important for innovation			
342	○ time zone coordination challenges			
343	○ time-bound			
344	○ trading capabilities			
345	○ traditional physical marketplace			
346	○ training			
347	○ training without application			
348	○ transparency			
349	○ digital trust			
350	○ underutilised technology investment			
351	○ unity mindset			
352	○ university graduates			
353	○ use drones for data gathering			
354	○ use of standard templates			
355	○ Use VPN			
356	○ value			
357	○ vast choice			
358	○ vast digital technology choices			
359	○ virtual design localisation			
360	○ virtual ecosystem			
361	○ Virtual first impressions			
362	○ virtual meetings			
363	○ virtual network as an experience enabler			
364	○ virtual network communication			
365	○ virtual network drives innovation			

366	○ virtual networks reduce project time			
367	○ virtual platforms			
368	○ virtual relationship formation			
369	○ virtual sandboxes			
370	○ virtual to physical encounter			
371	○ virtualisation			
372	○ win-win situation			
373	○ workforce transformation			