Carnegie Mellon University Qatar

Exploring Digital Resilience in Qatar: A Socio-Technical Perspective

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Abstract

The onset of the COVID-19 pandemic has resulted in major global disruptions to organizational and societal operations. To accommodate the ensuing restrictions many operations have shifted online. Anecdotally, most organizations and industries reported successful digital transitions. However, the extent to which individuals assimilated to such rapid transition remains largely unclear. Therefore, this study explores factors that enable individuals to develop resilience in the digital context. A new theoretical development is needed to fill this gap. In this research, an integrated conceptual model was developed derived from psychological resilience and Information Technology adoption disciplines. This integrated model aimed to provide a holistic framework of factors that constitute perceived digital resilience among individuals.

A quantitative methodology was employed and online questionnaires were created based on the model and distributed to participants in Qatari institutions. The Structural Equation Modelling was used as the main method of data analysis using the SmartPLS program. Results indicate that psychological resilience, digital literacy, self-efficacy and access to technology have significant influence on perceived digital resilience among individuals in Qatar. Moreover, community capital and family support have significant influence on psychological resilience.

Findings from this study hold important theoretical implications for the emerging field of digital resilience, specifically in establishing a foundation for future research, along with practical implications given the continuation of the pandemic induced restrictions. The implications to Qatar are particularly pertinent given its aspirations towards digital development and readiness.

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List of Abbreviations

CC: Community Capital

FS: Family Support

PS: Psychological Resilience

AT: Access to Technology

DL: Digital Literacy

SE: Self-efficacy

DR: Perceived Digital Resilience

CHAPTER 1. INTRODUCTION

1.1. Background of Study

Resilience is an ever-evolving concept adapted in various fields of study such as psychology, ecology, sociology, physics and child-development. Broadly, resilience involves bouncing back from a disruptive state (Garista & Pocetta, 2014). Due to the increasing interest in resilience research, resilience has been contextualized at an individual level, family level, community level, national level and cultural level (Fleming & Ledogar, 2008). This study is interested in resilience as an individual's trait. In an individual level, resilience refers to "the process of adapting well in the face of adversity, trauma, tragedy, threats or significant sources of stress" (Southwick et. al., 2014).

Given the digital revolution witnessed in this epoch, individuals showed new forms of resilience through technical innovations. Basic day-to-day activities have experienced a shift to a growing digital space resulting in an increased dependence on technology, especially during uncertain times (Westgarth, 2020). This new form of resilience in the digital space is known as "Digital Resilience". Digital resilience can be defined as the "utilization of technology to change practices in order to adapt to new circumstances while retaining the underlying function of the practices" (Weller et. al., 2013). This study examined digital resilience as the implementation of information technologies to recover, rebound and move forward when faced with challenges.

The pandemic of 2020 is an excellent case in point for a 'new normal' way of living (Dey et. al., 2020). The Coronavirus disease (COVID-19) has caused a worldwide disruption and chaos since it first spread across more than 207 countries and territories (Velavan and Meyer 2020). The world has never experienced a highly contagious virus with such magnitude. Hereafter, face to face contact was considered a health threat, significantly transforming daily modes of living to the remote digital space (Porter & Donthu, 2006). Covid-19 increased the dependence on information systems and technologies since governments-imposed lockdown and social distancing measures (Dey et al., 2020). The lockdown and social distancing measures led to a significant change in modes of work. Almost all employees were forced to work from home, with or without any prior experience in or preparation for such arrangements (Waizenegger, Cai & Bendz, 2020). Similarly, all educational institutions shifted to remote learning.

Lockdowns have also caused a huge surge in online purchases and uptake of entertainment related technology (e.g. streaming services, games, and music). These a few examples of many that highlight the massive digital transformation caused by the COVID-19 outbreak. As the world is going through an evolving phase with sharp and abrupt changes to individual's day-to-day norm, it is important to understand the influencing socio-technical factors causing individuals to create successful resilience in digital context.

1.2.   Research Motivation

This study is mainly motivated by two main factors. This includes the theoretical gap present in human behaviour aspect of digital resilience, and the increased dependence on technology to navigate through unprecedented times.

Firstly, much research investigates digital resilience from a cyber security perspective such as building digitally resilient infrastructure against attacks. For example, Fraga-Lamas et. al. (2019) proposes the great potential of applying blockchain technologies to the automotive industry while emphasizing its cybersecurity and resiliency features. The study holistically presents an approach to adopting blockchain technology in the automotive industry. The approach includes both the basics of designing blockchain-based cyber-resilient applications, and a detailed analysis on how to deploy and optimize blockchain technologies for the automotive industry (Fraga-Lamas et. al., 2019). Jin et al. (2017) similarly proposes a software-defined networking (SDN)-based communication network architecture to achieve resilient and secure microgrid operations. Through experimental results, the study demonstrates that the SDN-based communication architecture and applications can significantly enhance the resilience of microgrid operations against cyber threats.

Other studies looking at digital resilience from a cybersecurity perspective propose frameworks to evaluate or improve an organization's digital resilience given a cyber threat. Kleij & Leukfeldt (2019) proposed a framework that provides diagnostic capability on IT infrastructure for organizations and help them better prepare for emerging cyber threats, while emphasizing the its importance to business continuity (Kleij & Leukfeldt, 2019). Haque (2018) analyses the resilience property of different organizations during cyberattacks then propose comprehensive

cyber resilience frameworks which includes resilience metric organized in a hierarchy of several submatrices. Haque's (2018) metrics capture technical information about a system's security and resilience stance. Baikloy et. al. (2020) developed a cyber resilient capability model for cloud services providers to evaluate their organization in order to improve cybersecurity level in cloud computing services.

Another perspective in digital resilience research focus on technology readiness and capability. Weller and Anderson (2013) propose a framework for analysing an organization's digital resilience based on its ability to adapt to digital challenges. This framework is examined at two institutions (the UK Open University and Canada's Athabasca University) using two current digital challenges, namely Massive Open Online Courses (MOOCs) and Open Access publishing. Roberts & Townsend (2016) on the other hand develops processes for building resilience capability and resources in rural areas by utilizing an existing community resilience framework in combination with digital inclusion mechanisms. The aim of his study is to help rural areas develop digital resilience and combat the digital divide challenge. Tim et. al. (2020) proposed a framework to navigate both the potentials and pitfalls of technology leapfrogging, and ultimately build a pathway towards resilience and sustainability.

While existing studies focus on technical aspect of digital resilience and propose frameworks to build cyber and digital readiness, the human behaviour aspect of digital resilience has not yet been well understood, especially in the Middle Eastern region. Existing studies put emphasis on developing digital resilience on an organizational level while little research has been done on exploring socio-technical aspect of digital resilience during disruptive life events in an individual level. This study bridges the gap by looking at socio-technical on an individual level using residents of Qatar as a case study with Qatar as a national context.

Secondly, given the digital age, people showed new forms of resilience. Technology has become a crucial tool to navigate unprecedented times. The COVID-19 pandemic is a turning point to address the importance of digital resilience during unprecedented times. In a discussion titled Pandemic Readiness during Qatar's Smart City Summit 2020, speakers addressed how technology has played an important role in dealing with COVID-19 and how it can be used to mitigate the effects of a pandemic and future crises. Panellist Lana Khalaf, Country Manager, Microsoft Qatar – said: We have seen two years' worth of digital transformation in just two months. The pandemic has driven a systemic shift across every facet of daily life.

Governments needed to respond and plan differently, not only to cope with such a pandemic, but to also be ready to manage throughout the crisis and be resilient for the future (Joshi, 2020). We have a collective responsibility, rather than an opportunity, to rebuild as we move from a response phase, to a recovery phase, to a re-imagined stage and technology will continue to have a profound role in the journey beyond this pandemic (Khalaf, 2020). Thus, it is of utmost importance to understand the underlying socio-technical factors that enable individuals to use technology and navigate through tough times.

1.3.   Research Question, Aim and Objectives

This study aims to investigate the factors that enable individuals to create successful resilience in digital context, particularly in Qatar. To address the knowledge gap, the study proposes the following research question:

"What factors influence perceived digital resilience among individuals in Qatar?"

In addressing this question, the objectives of this research are:
1. To conduct a thorough literature review of the digital resilience domain and identify any theoretical gap.
2. To propose and validate a model to investigate the factors influencing perceived digital resilience among individuals, in the context of Qatar.
3. To understand the impact of socio-technical factors on perceived digital resilience among individuals.

1.4.   Research Methods

This study adopts a quantitative research method. A research model is proposed a that derives from theory of psychological resilience, and Information Technology (IT) adoption. The model conceptualized the factors that constitute perceived digital resilience, particularly in the Qatar context. The research model is formed based on the theory of Physiological Resilience Capacity adopted from the "Economic Resilient Behavior Model (Hua, 2018), and based on

multiple IT adoption models. Specifically, this study adopted from The Information Technology Adoption and Continuance Model by Sun and Jeyaraj, 2013 and The Revisited Technology Acceptance Model by Musa (2006). Variables in the model include: Community Capital, Family Support, Psychological Resilience, Access to Technology, Digital Literacy, Self-Efficacy and Perceived Digital Resilience. A total of six hypotheses are proposed in this study.

Measurement items of each factor were adopted from existing literatures. Data was collected through survey questions using Qualtrics platform. The unit of analysis is the individual level. Around over 300 online questionnaires are sent between March 2021 and April 2021. Participant recruitment invitations were sent out to potential participants through Qatari Institutions, with recipients encouraged to share the survey invitation. Once data were collected, the results were compiled and processed using SmartPLS measurement model and operational model from the data. The data were used to address the research question, leading up to the acceptance or rejection of each proposed hypothesis.

1.5.   Expected Contributions

This research seeks to contribute to digital resilience literature in several ways. Firstly, it focuses on the socio-technical aspect of digital resilience which is currently limitedly studied. Secondly, this research models perceived digital resilience among individuals while contextualizing it to fit Qatar's context. Thirdly, the digital resilience domain has not been well studied in the Middle Eastern region making this study unique to other digital resilience literature.

The remainder of this dissertation is structured as follows. The next chapter presents a literature review on resilience and digital resilience. Then, the development of research model and the proposed hypotheses are discussed, followed by the results and analysis of the study, discussion of the results, the implication of the results on future studies and closing remarks.

CHAPTER 2 LITERATURE REVIEW

2.1 Introduction

This chapter discusses the current literature and theories in the domain of resilience across different disciplines and in the domain of digital resilience. This chapter divides existing digital resilience literature into four main aspects, technical perspective, organizational perspective, national/societal perspective and the individual perspective. Through this, this chapter presents the literature gap, leading to the development of the proposed research model and hypotheses.

The literature review section is divided into seven main parts. The first section introduces the concept of resilience based on previous literatures from multiple disciplines. The second section defines digital resilience from two perspectives. The third section analyses the different frameworks and IT infrastructure proposed by previous studies to achieve digital resilience (technical perspective). The fourth section analyses the different frameworks proposed to evaluate, improve or measure an organization's digital resilience (organizational perspective). The fifth section analyzes studies exploring digital resilience against non-cyber challenges as a notional context such as national digital resilience against natural disasters, wars, pandemic, digital divide...etc. (national/societal perspective). The sixth section analyzes proposed frameworks to evaluate, improve or measure digital resilience among individuals (individual perspective). Finally, the seventh section summarizes the proposed research gap, which includes the lack of analysis of digital resilience from a socio-technical perspective, especially in the Middle Eastern region.

2.2. Concept of Resilience

Prior research on resilience show that resilience is a common concept among multiple disciplines. Extant research on resilience across disciplines can be categorized in two broad perspectives all while focusing on five orientations: fundamental science, ecological, cultural, technical and behavioral. All these orientations have piqued increasing attention. These are studies that develop conceptual frameworks of resilience, while others attempt to propose how

to measure resilience. Likewise, due to the multi-disciplinary nature of resilience, the term resilience has been defined in many studies of different domains.

The fundamental science orientation includes studies under the physics, biology and chemistry domain. The term "Resilience" was first introduced to academia by the Physics and Engineering domain. Resilience in physics and mathematics describes bouncing back to a prior equilibrium state after disruption (Hollings, 1996). It is considered a physical property of substances that can withstand severe conditions (McAslan, 2010). However, applying this principle to human systems, this view of resilience is challenged since the scientific perspective assumes that there is a "prior state" that humans need to return to after disturbances or disasters. Social-ecological systems like humans are more complex; when a human's state is disrupted by a disaster or an adversity, humans tend to adopt to the change instead of going back to their original state. Due to this complexity, research following the ecological orientation introduced "theory of social-ecological resilience" (LaFromboise et. al., 2006).

The theory of social-ecological resilience defines resilience as "the capability of a complex system to respond to adversity by trying to maintain system functions while recognizing changes, adapting to changes, and thus creating a new equilibrium for better system functions" (Hollings, 1996; LaFromboise et. al., 2006). This theory presents a holistic view of resilience in the social-ecological hybrid domain, it explains resilience in a complex dynamic system while emphasizing the adaptive nature of humans when coping with adversity. To be specific, human's interactions with their environment, whether it's people around them or the atmosphere they live in, influences their adaptations. Hence, builds their resilient capacity (Hollings, 1996; Lyon & Parkins, 2013).

Speaking of ecology, research on resilience in this domain also covers resiliency in nature. Holling (1973) first proposed the concept of resilience to ecology after his use of different reproduction curves revealed patterns of resilience in ecosystems. He defines resilience as "the persistence of relationships within a system and is a measure of the ability of these systems to absorb changes of state variables, driving variables, and parameters, and still persist" (Holling, 1973). The concept of resilience evolved considerably since Holling's (1973) seminal paper. Likewise, Hoppkins (2009) argues that the concept of resilience is useful in the climate-change jigsaw by developing a resilience framework to determine how systems can adapt and thrive in changing circumstances. He defines resilience as "the capacity of a system to absorb disturbance and reorganize while undergoing change, so as to retain essentially the same

function, structure, identity and feedbacks" (Hoppkins, 2009). Another ground breaking research on ecological resilience is Carpenter et. al. (2005). Carpenter et. al. (2005) used empirical models and measures to measure resilience of lakes and rangelands through which he developed "the adaptive cycle" which has been a foundation for many other ecological studies on resilience. This framework was discussed in detail in a later paper called "Resilience, adaptability and transformability in social–ecological systems" (Weller & Anderson, 2013).

As for the technical orientation of resilience, most of the research focus on resilience against cyber-attacks and crimes. Kleij & Leukfeldt (2019) combines four functions of resilience and human behavior to develop a conceptual framework called "Cyber Resilient Behavior Model". The framework tends to provide diagnostic capability to organizations and help them better prepare for emerging cyber threats, while emphasizing the practicability of the human aspects of cyber security and its importance to business continuity (Kleij & Leukfeldt, 2019). Similarly, Hua (2018) measures individual resilience to cyberterrorist attacks. However, focuses on financial systems. Hua (2018) proposes a research model which integrates resilience with fear appraisal to address individuals' fears of cyberterrorist attacks on financial systems. This study develops the individual economic resilient behavior model to predict individual behavior after cyberterrorist attacks. Other studies such as Haque (2018) and Shalamanov (2019) analyze the resilience property of different organizations during cyberattacks then propose comprehensive cyber resilience frameworks which includes resilience metric organized in a hierarchy of several submatrices. Haque's (2018) metrics capture technical information about a system's security and resilience stance while shalamanov's (2019) metrics lean towards the administrative side as they support organizational and human risks analysis.

The behavioral orientation of resilience research covers the disciplines of psychology and sociology. In psychology, resilience is defined "as an individual's capacity to remain functional by absorbing, recovering from, and adapting to adversity". It is seen as a natural and instinctive characteristic built in all humans through adaptation and evolution (Bonanno, 2006). Given that, it is argued by Masten (2001) that psychological resilience comes from both a person's inner system and the external environments he or she interacts with, for instance one's family and community. Following Masten's (2001) claim, many studies investigated factors from the family, community and society that trigger psychological resilience in an individual. According to Norris et. al. (2008), a community with coping resources, skills, and knowledge is a factor of building psychological resilience as it provides social support to its members and can teach them to take necessary actions to tackle adversity. Similarly, an individual's family can also be

considered a factor in terms of the family's resources, structures, the interactions between the family members, their financial resources and psychological, cognitive, and emotional supports (Ali et. al, 2010; LaFromboise et. al, 2006).

Resilience could also have some cultural dimension; there is a reasonable amount of research attempting to analyze the influence of culture on resilience. To take a case in point, Theron's et. al. (2015) book chapter "Youth Resilience and Culture" argue that there are certain aspects of culture which shape resilience for families, communities, and governments. Likewise, Panter-Brick and Eggerman (2012) in their book chapter "Understanding culture, resilience, and mental health: The production of hope" argue that cultural values are the building blocks for resilience as culture can influence one's meaning of suffering and hope for the future.

2.3. Defining Digital Resilience

Resilience can be defined as the ability, and tendency, to bounce back. It is also seen as a process of adapting well in the face of adversity, trauma, tragedy, threats or significant sources of stress (Windle, 2011). During the last decades, this construct has been contextualized in different settings and disciplines and only lately, it has been introduced into the digital field.

As a concept, digital resilience is much talked about but it is still ill-defined. There have been multiple attempts by scholars to define digital resilience. Some definitions agree that digital resilience is the technical capabilities of systems and infrastructure to show resilience. To take a case in point, Wright (2016) argues that digital resilience refers to applying resilient characteristics to digital data and systems. For communities, or organizations or any other entity to be digitally resilient, data and tools should be freely accessible, interchangeable, operational, of high quality, and up to date. Other definitions take a behavioural orientation as they refer to digital resilience as technology adoption.

Digital resilience in academia is mostly talked about in terms of cybersecurity, for instance a recent McKinsey blog, which says organizations are working towards a situation in which they design their business processes and IT systems to "facilitate the protection of critical information and to implement strong cyber defences and effective plans for responding to

cyberattacks." While that is true, Bhagat & Kim (2020) argues that digital resilience should be seen much more widely than just through a narrow cybersecurity focus. Bhagat & Kim (2020) define digital Resilience as "an organization's ability to maintain, change or recover technology-dependent operational capability". In other words, digital resilience is the ability to adopt new digital technology solutions quickly and seamlessly in order to recover, rebound and move forward if things go wrong.

In a similar vein, Weller et. al. (2013) in their study "Digital Resilience in Higher Education", define digital resilience as the utilization of technology to change practices in order to adapt to new circumstances while retaining the underlying function of the practices. In other words, digital resilience is implementing new technology to recover, rebound and move forward when faced with challenges. Weller et. al's (2013) definition of digital resilience focuses on digital resilience in terms of digital transformation; digitalizing processes to survive threats and challenges, yet the main function and purpose of these processes stay the same whether digitalized or not.

Garista and Pocceta (2014) conducted a study using the Matrix method for collecting and analyzing data, in order to describe a clearer definition and application of Digital resilience. As a result of their study, they defined digital resilience as "a way of coping with the digital challenges (MOOCs, Open Access Publishing, risk), or resilience as the final aim of a project by implementing digital methods (digital storytelling, social networks etc.)".

2.4. Technical Perspective

Studies exploring the technical aspect of digital resilience are interested in the IT infrastructure supporting digital resilience. IT Infrastructure ranging from electricity, telecommunications and internet access to state-of-the-art information systems are central to support digital resilience. According to a study by Hallegatte et al. (2019), access to basic infrastructure is a key driver of economic development. The study establishes a framework for comprehending infrastructure resilience, or the ability of infrastructure systems to function and meet the needs of users during and after a natural disaster. It focuses on four infrastructure systems that are critical for economic activity and human well-being: water and sanitation systems, which

include the generation, transmission, and distribution of electricity; power systems, transport systems and telecommunications, including telephone and Internet connections (Hallegatte et al., 2019).

On the other hand, some studies focus on the information systems and information technology used to achieve digital resilience. Research done by Wandji et al. (2019), for example, proposes a cyber-resilient framework for the US Navy. The study starts by looking at the vulnerabilities and threats faced by the US Navy. Accordingly, the study investigates software that explicitly reduces these vulnerabilities and also incorporates resiliency principles. The study looks into software technology specifically because the most important Navy systems functionalities are undertaken by software. Similarly, Chen's et al. (2020) study established a two-player three-stage game framework to capture the dynamics in the infrastructure protection and recovery phases. According to the study, both cyber and physical attacks can compromise infrastructure networks. Providing dependable and dependable services necessitates the development of a secure and resilient networked system. Their infrastructure network designer's goal is to keep the network connected before and after the attack, whereas the adversary's goal is to break the network by compromising a set of links (Chen's et al., 2020).

A study by Fraga-Lamas et. al. (2019) proposed the great potential of applying blockchain technologies to the automotive industry while emphasizing its cybersecurity and resiliency features. The study explored basics of designing blockchain-based cyber-resilient applications, and analyzed how to deploy and optimize blockchain technologies for the automotive industry (Fraga-Lamas et. al., 2019). Jin et al. (2017) similarly proposes a software-defined networking (SDN)-based communication network architecture to achieve resilient and secure microgrid operations. Through experimental results, the study demonstrates that the SDN-based communication architecture and applications can significantly enhance the resilience of microgrid operations against cyber threats.

2.5. Organizational Perspective

Studies exploring the digital resilience at an organizational level analyze or propose frameworks to evaluate, improve or measure an organization's digital resilience. A study by Casalino et al. (2019), for example, argues that improving enterprises' "digital resilience" is

becoming increasingly important in order to balance the ongoing digital transformation. Digital resilience is now and, in the future, a critical factor for the success of any SME (Small and Medium Enterprise). Digital resilience should be considered as an integral part of any company's strategy and mission, and it should be centered on all involved employees in SMEs. As a result, the study examines the key assumptions about decision-making, organizational change, change management, risks prevention and knowledge management which shape the basis for an effective and successful process of digital transformation (Casalino et al., 2019). Another study by Bai et al. (2021) constructed an index for firms' resilience to the Covid-19 pandemic by assessing the work-from-home (WFH) feasibility of their labor demand. The study found that public companies with high pre-pandemic WFH index values had significantly higher sales, net incomes, and stock returns than their peers during the pandemic, using a difference-in-differences framework (Bai et al., 2021).

Kleij & Leukfeldt's (2019) study likewise proposed a framework that provides diagnostic capability on IT infrastructure for organizations and help them better prepare for emerging cyber threats, while emphasizing the its importance to business continuity (Kleij & Leukfeldt, 2019). Haque's (2018) study analyzes the resilience property of different organizations during cyberattacks then propose comprehensive cyber resilience frameworks which includes resilience metric organized in a hierarchy of several submatrices. Haque's (2018) metrics capture technical information about a system's security and resilience stance. Baikloy et. al. (2020), on the other hand, developed a cyber resilient capability model for cloud services providers to evaluate their organization in order to improve cybersecurity level in cloud computing services.

2.6. National/Societal Perspective

Studies looking at the national/societal perspective explore digital resilience against societal challenges such as digital resilience against natural disasters, wars, pandemic, digital divide, etc. For instance, a study by Tim et al. (2021) investigates the Digital Social Innovation (DSI) — the creative application of digital technology to solve societal problems — and how it can help a country achieve sustainable development. They present an in-depth DSI case study in which grassroots communities in a remote county used ecommerce to leapfrog out of poverty and become successful entrepreneurs with online businesses in their paper. (Tim et al., 2021). Speaking of rural areas, a study by Roberts & Townsend (2016) looked at how broadband

Internet access and online activities affect rural creative work and, in turn, how this allows people to engage at various levels in their rural communities, leading to resilience in both the community and digital context (Roberts & Townsend, 2016). Roberts'& Townsend's (2016) study on the other hand develops an established community resilience architecture and digital inclusion framework, which builds processes for building resilience capacity and services in rural areas. His research aims to aid rural communities in developing digital resilience and combating the digital divide.

Other studies look at digital resilience of refugees during war. Udwan's et al. (2020) for example conducted a detailed case study of Syrians in the Netherlands Their article looked at the impact of the welfare state's retreat and the unfolding digital transitions on marginalized people's resilience tactics, such as refugees. While acknowledging the systemic violence and historic trauma that many refugees have endured, the study concentrated on how refugees are expected to develop resilience. (Udwan et al., 2020). Another similar study by Gillespie et al. (2018) examines the role of smartphones in the journeys of refugees. Smartphones are lifelines for Syrian and Iraqi refugees, similar to water and food. Smartphones aid them in the digital passage to Europe by facilitating information, communication, and migration flows. They enable regular contact with family, friends, smugglers, and those who assist them, as well as the planning, navigation, and documentation of journeys. However, European policies expose refugees to new forms of exploitation and surveillance through these smartphones (Gillespie et al., 2018).

In terms of natural disaster management aspect of digital resilience, Talley (2020) conducted a study involving technology used to reinforce discussion around traditional and new approaches to the management of natural disasters. According to the study, Governments and communities must prepare for, respond to, and recover from disasters more than ever before. Disaster management is a big data issue that necessitates a public-private partnership since technology is the link that can connect disaster management capabilities from beginning to end (Talley, 2020). Conversely, a study by Fan et al. (2021) presents a vision for a Disaster City Digital Twin paradigm. This study suggests the need for interdisciplinary convergence in the field of crisis informatics and disaster information and communication technology. Digital resilience against natural disaster requires artificial intelligence algorithms combined with methods to enhance situation evaluation, decision-making, and teamwork among different stakeholders;

and enable greater insight into network complexities of complex disaster management and human activities (Fan et al., 2021).

2.7. Individual Perspective

Unfortunately, while resilience has been explored at an individual level (highlighted in chapter 3), individual perspective specific to digital resilience are under studied in the literature. There are limited studies exploring or proposing frameworks to evaluate, improve or measure digital resilience among individuals. Among the few studies exploring digital resilience at the individual level is a study by Hua et al. (2018). Drawing from the theory of social-ecological resilience and individual psychological resilience and fear appeals, Hua's et al. (2018) study proposes an economic resilient behavior model to study individual psychological resilience in the context of cyberterrorist attacks on financial systems. The focus of the study is individual behavior in terms of financial management. Equivalently, Budak et al. (2021) conducted a study that combines consumer behavior theories with resilience theories. It aims to bridge the aforementioned gap and follow the study trail to learn more about how customers respond to online privacy violations and the behavioral implications of the stressful occurrence. Hence, the study proposed a set of variables to serve as determinants and behavioral consequences of consumer resilience with regard to online privacy violation.

2.8. Why Qatar?

This research explored socio-technical aspect of digital resilience with Qatar as a case study. Qatar is an independent nation situated in the Middle East. Qatar is one of the advancing countries in the digital and cyber space. Slightly smaller in area than the U.S. state of Connecticut, Qatar inhabits a peninsula extending into the Arabian Gulf (Elshenawy, 2017). Qatar has been ruled by the House of Thani, and is currently under the leadership of HH Sheikh Tamim bin Hamad. A of 2020, there are approximately about 2.8 million people live in Qatar (Fromherz, 2017). Arabic language is the mostly spoken language and the official language in Qatar, however, English language is also widely spoken by the people in the nation (Kamrava, 2015). Qatar's economic prosperity is derived from the extraction and export of petroleum

making it richest country in the world in terms of GDP per capita (Vohra, 2017). Despite possessing enormous deposits of natural gas, Qatar was known worldwide after being appointed the host of the FIFA 2022 World Cup and hosting the Asian Cup multiple times.

In addition to sports, Qatari government has placed importance on the national digital development and security. For example, as part of Qatar's efforts to address current and emerging cyber threats, a National Cyber security Strategy has been developed in 2015 by Qatar's National Information Security Committee to provide a governance structure to address cybersecurity issues collectively at the highest levels of government. One of its objectives is to empower the Qatari workforce and raise the level of readiness in all sectors. This objective is achieved through conducting annual National Cyber drill workshops for organizations which focus on topics related to identifying and detecting cyber threats in proactive ways and how to deal with them (Qatar National Cyber Security Strategy, 2014)

Qatar has implemented many initiatives to reply their government services and transforming to digital nation. To take a case in point, ministries across the government have joined together to accelerate digital government initiatives to make Qatar's government more efficient, effective, accessible, and customer-centric. Building on the progress made over the past years, Qatar Digital Government program will better serve individuals and businesses, create efficiency in government administration, and develop a more open government with enhanced participation of citizens and residents (motc.gov.qa).

In a similar vein, the Qatari government has grown its dependent on the digital way of living, particular during COVID pandemic. Qatar recently hosted its Doha Smart Cities Summit on the 24th of November 2020 discussing the vital role of technology in tackling different challenges, with the current Covid-19 pandemic as a focal point. Reem Mohammed Al Mansoori, Undersecretary of Digital Society Development at Qatar's Ministry of Transport and Communications, highlighted at the summit that Qatar holds initiatives to create a digital society through the use of technological advancement. The MoTC launched the TASMU Smart Qatar Program. TASMU harnesses advanced technology and innovation to deliver smart solutions and applications across five priority sectors transport, healthcare, logistics, environment, and sports she said (Olusegun, 2020). The summit outlined the importance of digital resilience through technology utilization. Doha Smart Cities Summit is one of the platforms in Qatar for experts, professionals, and a broader audience to share, inspire, and

shape Qatar in its digital society 2030 vision (Saleem, 2020). This shows the growing interest of digital resilience in Qatar. Yet, there is no existing scholar study in the area of digital resilience in Qatar. Not to mention the feasibility of data collection since the researchers of this study are currently residing in Qatar.

2.9. Theoretical Gap

As presented earlier in this chapter, there is a clear knowledge gap in the digital resilience literature in terms of the individual perspective. While the technical, organizational and societal perspectives to digital resilience attracted research attention, studies on the human perception in this domain remains scarce, especially in the Middle Eastern region. Existing studies put emphasis on fostering digital resilience among organizations and societies, but don't necessarily promote digital resilience among individuals during disruptive life events. Likewise, Existing studies focus more technical aspect of digital resilience. Most of the proposed frameworks address the technologies used in achieving digital resilience instead of the human factor. This study bridges this gap by looking at socio-technical factors at an individual level within the Qatari Context. The, next chapter presents the research model and hypotheses development.

CHAPTER 3. THEORETICAL FRAMEWORK

3.1. Introduction

This chapter will focus on presenting the theoretical basis which contributes to the model development. This chapter will review and analyze the theory of psychological resilience adopted from Hua et al. (2018), and analyze multiple theories of technology adoption through which the proposed model is based on. Specifically, this study adopted from The Information Technology Adoption and Continuance Model by Sun and Jeyaraj, 2013 and The Revisited Technology Acceptance Model by Musa (2006). Additionally, this chapter will delve into the model development and the formed hypotheses to be tested in this study.

3.2. Individual Resilience Literature

Previous studies on individual resilience pointed at several contributing factors, or antecedents, that enhance resilience (Joseph & Linley, 2006; Herrman et al., 2011). Among the variables that have been recognized as important for resilience in different contexts, personality variables are one of the most important. Among the most important antecedents to personal resilience include different psychological factors such as self-esteem, personality traits, locus of control, optimism, self-efficacy (Nakaya et al., 2006). Other factors are of a socio-demographic type, and typically include income, education, age, occupation, and age (Campbell-Sills et al., 2009; Carver et al., 2010). In addition, various resilience aspects should also be connected to different psychological well-being factors, as individuals with higher levels of resilience are in turn more successful at improving their psychological well-being (Fredrickson, 2001). Individual resilience is influenced by wider micro and macro environmental factors. Examples of micro-environmental factors include social support, family relationships, peers, and stability; while macro-environmental factors generally include community, institutions, and cultural factors (Luthar & Cicchetti, 2000). Given the importance of psychological resilience, this study expects psychological resilience to be positively associated to individual's digital resilience.

In addition to psychological resilience, individual characteristics such as digital literacy and self-efficacy has been found as factors influencing individual resilience online (Budak et al., 2021). Vandoninck, d'Haenens and Roe (2013) investigated the factors that influence online

resilience among young people in Europe. Their research showed that increased digital literacy levels correlated with greater resilience levels, including better coping strategies. Using a sample of students, they proved a positive relationship between digital resilience and digital literacy. Similar results were also obtained by Tran et al. (2020).

In investigating individual characteristics influencing individual resilience as antecedents, Budak et al. (2021) found self-efficacy emerging as a potentially significant variable that assesses optimistic self-beliefs that help in coping with a variety of stressors in life. Schwarzer and Jerusalem (1995) determined that if a person is dealing efficiently with unexpected events and solving problems, these abilities might be crucial to confronting disruptive event. Acknowledging the need to adjust is attributed to an individual cognitive flexibility. Due to this characteristic a person sees alternatives, exhibits a willingness to adapt to new situations, and maintains self-efficacy in being flexible (Martin & Rubin, 1995). Taking all this into consideration, this study expects digital expertise (digital literacy) and self-efficacy to be positively associated to individual's resilience.

Moreover, Budak et al. (2021) asserts that individuals' demographic characteristics can also explain resilience in an online environment. Roberts et al. stressed that rural areas significantly differed in the delivery and use of digital technologies, which is visible in the accessibility of different technologies, IT infrastructure, or IT education, which then affects their resilience in the digital world. Budak et al. (2021) thus speculate that urban residents might show higher levels of resilience because of higher and better access to technology. Taking all this into consideration, this study expects access to technology to be positively associated to individual's resilience.

3.3. Psychological Resilience Theory

Resilience from a human behavior perspective roots back to the field of sociology, specifically the theory of social-ecological resilience (Norris et al., 2008). The theory of social-ecological resilience defines resilience as a capability of an entity to respond to danger by recognizing change and adapting to it all while maintaining the entity's functions, and thus creating a new equilibrium (LaFromboise et al., 2006). Based on the theory of social-ecological resilience, Bonanno et. al. (2006) defines psychological resilience as a capacity demonstrated by

individuals under pressure and stress of disruptive life events. Similarly, Lyon & Parkins (2013) explain psychological resilience as a complex dynamic system composed of a myriad of sub systems. In other words, individuals are a complex system that interacts with subsystems in their environment which help build their resilient capacity. Given the social-ecological view of psychological resilience, this study defines psychological resilience as an individual's capacity to remain functional when faced by disruptive life events by absorbing, recovering from, and adapting to adversity.

Psychological resilience is critical for an individual to recover from an adversity and adapt to more resilient behavior (Hua et al., 2018). Prevailing research further indicates that psychological resilience leads to positive, adaptive outcomes and that psychological capacity of resilience is behaviors taken by individuals in a complex system to respond to changes in an attempt to create a new, possibly better, equilibrium in the system (Bonanno, 2006). Existing research also found that psychological resilience is not a trait, rather it is a capacity that can is developed (Lyon & Parkins, 2013). Psychological capacity of resilience comes from both an individual's inner system and external environments, specifically an individual's family and communityy (Masten, 2001). As such, psychological resilience is viewed to be supported by primary factors coming from a network of social support including family, community, and society (Pinkerton, 2007; Lyon & Parkins, 2013). Therefore, this study focuses on the direct social network of individuals in terms of their communities and their families.

According to Pfefferbaum et al. (2011), a rich community in terms of resources, skills, and knowledge of coping can socially support its members and help them build resilience and remedy the impact of adversity or disruptive events. Similarly, individuals in a supportive community can get important guidance to be resilient (Norris et al., 2008). In a similar vein, family characteristics, specifically family resources, structures, and interactions play an important role in the development of an individual's resilience (LaFromboise et al., 2006). A family's financial resources and psychological, cognitive, and emotional support influence family members and support their action more rapidly (Ali et al., 2010). Hence, in general, people with family support are more resilient and are able to better cope with stress and adversity in their life (Pinkerton, 2007).

Drawing from the theory of social-ecological resilience and the literature on individual psychological resilience, Hua et al. (2018) proposes an economic resilient behavior model to study individual psychological resilience in the context of cyberterrorist attacks on financial

systems. Adopting the theory of social-ecological resilience, Hua et al.'s (2018) model suggests that in order to build resilience, individuals must interact with their environments, their community and family. Individuals who get more support from their family and have more resources in their community are more likely to absorb shocks and show resilience during disruptive or adverse times. Moreover, resilience leads to positive outcomes resulting in more adaptive behavior.

Given the alignment between Hua et al.'s (2018) model construct and earlier literature of individual resilience, this study adopted the psychological resilience theory construct from Hua et al.'s model and adapted it to fit the digital context of the study. Nevertheless, Hua's (2018) model focuses on economic behavior and does not incorporate the technology usage aspect of digital resilience. Therefore, we further investigate the digital dimension through IT adoption literature.

3.4. Technology Adoption Theories

Information Technology Adoption and Continuance Model by Sun & Jeyaraj (2013)

The characteristics or dispositions of the individuals adopting or considering the adoption of IT innovations also play an important role in their intentions to adopt innovations. As summarized by Kwon et al. (2007), individual characteristics such as self-efficacy, and digital expertise are among the salient individual characteristics examined in technology adoption research.

These individual characteristics are expected to positively impact the individual's intention to adopt the innovation. During the early stage, non-adopters are likely to attach importance to their own characteristics in their decisions to adopt the innovation (Chau & Lung Hui, 1998). During the later stage, individual characteristics are not likely to be influential because non-adopters may not possess similar levels of expertise or have the confidence about their capability to use a new information system.

The roots of the concept are grounded in the Self Efficacy Theory (SET) proposed by Bandura (2005) which in turn came from the Social Cognitive Theory. Bandura (2005) defined self-efficacy as "the judgments of how well one can execute courses of action required to deal with prospective situations". According to the theory, self-efficacy is the most important determinant for behavioural change since it leads to building up of coping behaviour. According to SCT, there are two opposing factors that influence behaviour of the users. Positive contribution is made by the factor "affect" which is the extent to which an individual likes his job. On the other hand, negative contribution to desired behaviour is made by the factor "anxiety". Both high self-efficacy and high digital expertise increase an individual's confidence with using technology and lowers anxiety. Given the alignment between Information Technology Adoption and Continuance Model and earlier literature of individual resilience, this study adopted the self-efficacy and digital expertise (digital literacy) constructs.

The Revisited Technology Acceptance Model by Musa (2006)

Davis (1989) developed the TAM from fundamentals of the TRA developed by Ajzen and Fishbein, and the TPB by Ajzen (Musa, 2006). TRA and TPB emphasize prediction of behavior when faced with decisions, whereas TAM explains technology acceptance behaviors. Davis (1989) formed this model around two premises: perceived usefulness of technology and perceived ease of use of technology. Mathieson et al. (2001) extended Davis' (1989) model by including intention to use technology that is a premise of the theory of planned behavior (TPB) (Chen et al., 2011). Musa (2006) further extended the TAM model to include accessibility and availability factors.

According to Musa (2006), Drawing on Sen's capability theory of human development, the ability or capability of individuals to achieve the things they value doing or being given the various contextual constraints that exist. Sen's capability approach can be relevant as an element of impact assessment of development interventions such as IT because it helps us focus on what is of intrinsic value of individuals, rather than on the mere supply of ICT infrastructure that may be driven by national or global interests. For example, having access to food would not make some-one that has some form of eating disorder to achieve a healthy state of being (Musa, 2006). Similarly, although access to ICTs is a prerequisite to its use, individual

differences in time and space, as well as capabilities and choice, may also play a role on the use, value, and application of the ICTs (Alampay et al, 2006). Therefore, Musa (2006) extends the TAM model to account for the accessibility and exposure to information technology.

The "Accessibility of Technology to Individual" in the new model refers to the technology that is in place and available for use. This would include related ITs such as computers, telecommunications networks, Internet, or any machinery or equipment that constitutes "a technology" in a user's world. Of relevance here is the fact that merely having access to technology is one thing, but the maturity and exposure of a user in the use of related technologies over time as well as the existence of appropriate technological infrastructure in a given region significantly helps users to put a given technology to its full potential (Alampay et al., 2006). The revised model captures the importance of the actual availability of technology and links this to perceptions of socioeconomic environment, which ultimately gets reflected in the value placed by individuals on technology to enhance their lives. Given the alignment between the revisited Technology Acceptance Model and earlier literature of individual resilience, this study adopted access to technology construct.

3.5. Proposed Research Model

Drawing from the theory of psychological resilience and literature on Information Technology adoptions, this study proposes a research model (see Fig. 1) to study socio-technical factors influencing perceived digital resilience among individuals in Qatar. Previous studies pointed at psychological factors to be the most important in developing individual resilience (Budak et al. 2021). Adopting the theory of psychological resilience capacity from Hua's (2018) "Economic resilient behavior model", the model suggests that individuals need psychological resources to develop resilience, influenced by their community and family. People supported by their community and families, in terms of resources, are more likely to deal with adversities and develop psychological capacity of resilience. Having a resilience capacity, therefore, leads to adaptive resilient behavior (Hua et al. 2018). Nevertheless, Hua's (2018) model focuses on financial behavior and does not incorporate the digital aspect of resilience. Therefore, we further investigate the digital dimension through IT adoption literature.

Consequently, Therefore, we further investigate the digital dimension through IT adoption literature. In addition to having a psychological resilience capacity, individuals must be technologically well-placed to adopt new technologies and engage in digital transformation. According to Mark and Semaan (2008), individuals develop resilience by using IT as resource to modify existing routines, develop new routines and changing behavioral patterns when coping with the disruptive events. The proposed model, therefore, introduces three factors derived from existing various IT adoption theories that enable individuals to adopt IT as a resilience mechanism. Access to technology (Musa 2006), Digital literacy and Self-efficacy (Sun and Jeyaraj 2013) have been reoccurring factors in multiple IT adoption studies. These factors play a role in the willingness and readiness of individuals to adopt technology for resilience purposes. The below section discusses the development of research hypotheses.
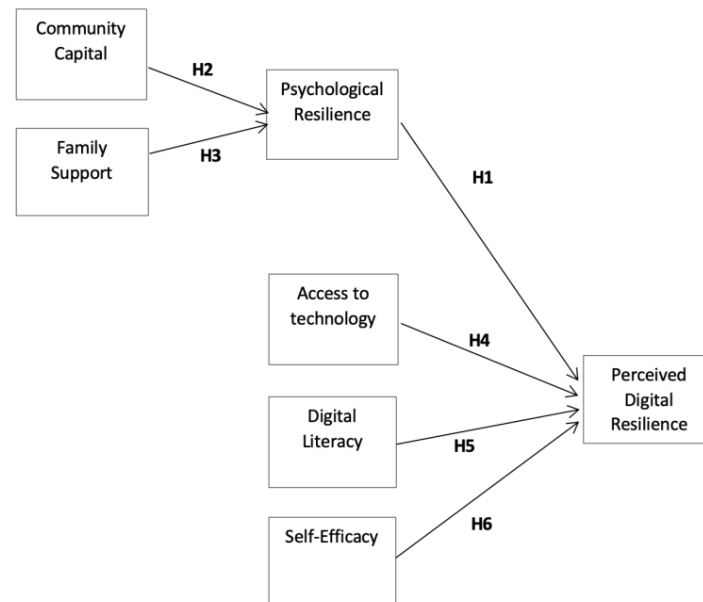
Figure 1. Proposed Conceptual Model

3.6. Proposed Hypothesis

Psychological Resilience

Psychological Resilience refers to an individual's capacity to remain functional by absorbing, recovering from, and adapting to adversity (Hua et al. 2018). Research in psychology found that resilient people can better cope with loss, trauma, and life stress (Bonanno 2004). Other

studies also found that resilience is an essential factor for individuals to cope with mental health issues such as anxiety, depression, and posttraumatic stress disorder (PTSD) when facing war or terror (Wadsworth 2010). These studies reveal that there is a strong relation between an individual's metal state and his or her resilience capability. Prior research found that the psychological capacity of resilience enables an individual to properly adapt to stress and adversity, and notably, that psychological resilience is not a trait and can be developed in processes (Lyon and Parkins 2013). Existing psychological resilience capabilities in an individual builds digital resilience as it provides them with the cognitive ability to adapt to new technology and change their lifestyle to adapt to digital transformations. This study looks at the concept of psychological resilience as influenced by *community capital* and *family support*, discussed next. Given this logic, we propose that:

H1: Psychological resilience has a positive relationship with perceived digital resilience.

Community Capital

Community Capital refers to resources that a community can provide its members to respond to and recover from an adversity (Hua et al. 2018). Hua (2018) asserts that community support is very likely to contribute to an individual's psychological resilience when they face difficulty and adversity because a community can influence people's reactions to crises as well as help them better cope with, and adjust to, the situation. LaFromboise et al. (2006) found that if an individual feels support from their community; they have higher chances of being resilient in the face of adversity. Other studies also propose that individuals who turn to people in the community seeking emotional support demonstrate a strong tendency toward resilience (Norris et al. 2008). In any social or cyber dilemma, victims of adversities may suffer emotional and psychological shock, they may even experience nationwide chaotic situations. Having a strong community support may help individuals handle their difficulty and provide needed emotional support, legal counsel, financial support and other forms of assistance. With such strong support, people are more likely to demonstrate high psychological resilience and adapt to new norms. Thus, we hypothesize as follows:

H2: Community capital has a positive relationship with building psychological resilience.

Family Support

Family support refers to resources that a family can provide to an individual to respond to and recover from an adversity (Hua et al. 2018). Existing studies show that family characteristics also play a major role in building psychological resilience capabilities in an individual (Norris et al. 2008). An individual's family resources, structure, and interactions influence and supports their actions. Thus, family-level resources and psychological, cognitive, and emotional support are strongly associated with an individual's resilience (Ali et al. 2010). Due to family support, people are, generally, more resilient and able to better cope with stress and adversity in their life (Hua et al. 2018). With such strong support system, individuals are more likely to demonstrate high psychological resilience and adapt to new norms. Thus, we propose the following hypothesis:

H3: Family support has a positive relationship with building psychological resilience.

Access to Technology

Access to technology encompasses the availability of technology, the strength of the supporting infrastructure and the financial ability to access technology. Access to IT is a prerequisite to its use. The ability or capability of individuals to use and value technology depend on their application of the IT that exist (Musa 2006). Similarly, Porter et. al. (2006) suggests that use of computing technologies is highly dependent on the support infrastructure. Before deciding to adopt technology, individuals must first be exposed to and have access to that technology. Once the technology is accessible and perceived as easy to use, an individual will more likely be try it. This acceptance will consequently fuel the adoption of a diverse range of technologies (Niehm et al. 2010). Conversely, assess to technology allows utilization of technology, especially during disruptive events. Thus, we propose the hypothesis:

H4: Access to technology has a positive relationship with perceived digital resilience.

Digital Literacy

Digital literacy refers to an individual's skills and abilities that enable him or her to adopt and use technology with relative ease (Sun and Jayaraj 2013). Sun and Jayaraj (2013) argue that digital expertise and literacy, impact an individual's intention to adopt an innovation. Inadequacy of digital skills can cause an individual to feel insecure, therefore cause the individual to feel disinclined to use technology. Conversely, it causes an individual to view technology as threatening and overwhelming. This further reinforces reluctance to use

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technology as a coping mechanism (Mac Callum et al., 2014). Thus, we propose the following hypothesis:

H5: Digital literacy has a positive relationship with perceived digital resilience.

Self-Efficacy

Self-efficacy refers to the judgment of one's capability to use a new information system (Compeau and Higgins, 1995). Unlike digital literacy, self-efficacy is not a measure of skill; rather, it reflects what individuals believe they can do with the skills they possess (Eastin and LaRose, 2000). According to Sun and Jayaraj (2013), the higher an individual's self-efficacy, the more likely that the individual will adopt or use a technology. Self-efficacy initiates a "can do" cognition in an individual which mirrors a sense of control over a situation and increases optimism. Thus, it represents a self-confident view of the individual's technical capability to deal with certain stressors in life and encourages adoption of technology during disruptive events (Schwarzer and Warner, 2013). Thus, we propose the hypothesis:

H6: Self-efficacy has a positive relationship with perceived digital resilience.

3.7. Conclusion

Consequently, based on previous studies on individual resilience, the proposed research model suggests that individuals need psychological factors to develop resilience. Adopted from Hua et al. (2018), people who are supported by their families and have a high community capital are better able to cope and adapt during disruptive times. However, the psychological resilience theory adopted from Hua et al. (2018) doesn't justify the digital aspect of resilience. Hence the proposed research model introduces three additional factors from IT adoption theories. The model suggests self-efficacy and digital literacy, adopted from Sun and Jeyaraj (2013), increase confidence in using technology which in turn increase willingness to use technology during disruptive times. Likewise, access to technology, adopted from Musa (2006) increases individuals' ability and capability to use technology during stressful times.

CHAPTER 4. RESEARCH METHODOLOGY

4.1. Introduction

This chapter will focus on presenting details on the research strategies used for the study. Survey questions for this study were created following Hua's Economic Resilient Model and multiple different IT adoption model surveys. A quantitative method was used in this study to generate numerical data and usable statistics. Given the focus of the research question is on identifying factors, a quantitative research approach is favored, due to its alignment with the research objectives as quantitative research can incorporate survey questionaires with measurement items. Specifically, the unit of analysis, data collection methods, construct measures, data analysis method, and the ethical considerations will be addressed in this chapter.

4.2. Unit of Analysis

This study follows a quantitative research method. The unit of analysis in this study are Qatari residents and locals, 18 years and older. Participant recruitment was done through Qatari institutions on behalf of this study's researcher. Due to IRB standards, direct content with participants were not approved. Hence, the surveys were distributed through second party institutions, mainly to employees of these institutions. The study followed the snowball method in the sense that participants were asked to forward the survey to others whom they think would be interested in the study. To be eligible for the study, potential participants must satisfy the following requirements:

- 18 years or older
- Qatar citizen or resident currently residing in Qatar for 1 year or more
- Able to read, speak and write in English

The above participant criteria serve as a control variable, aiming to reduce study results divergence. Before entering the questionnaire, potential participants were asked to agree to these terms. They would not be allowed to participate if they do not agree with either of them.

4.3. Data Collection and Sample Size

Online surveys were sent to a sample of over 300 users. Data were collected from March 2021 to April 2021. 150 surveys were received in this study of which only 105 were valid. This collection process is conducted as shown below:

1. Participant recruitment invitations were sent out to participants through Qatari Institutions including QSE and AlFardan Exchange. These invitations with the link to the questionnaires attached were sent to over 300 employees over email.
2. Afterwards, the data collection process followed the snowball method, which required the recruited people to forward the invitation to their connections.

4.4. Measure of Construct

The following table displays the questionnaire items provided for the participants. All questionnaire items were measured using the Likert-scale, ranging from 'Strongly Disagree' (1), Neutral (4), to 'Strongly Agree' (7). Questionnaire items were taken from existing literatures and theoretical models and adapted in the context of studying digital resilience taken from an individual's perspective.

Question Items				Adapted From / Developed
Community Capital	CC	Refers to resources that a community can provide with its members to respond to and recover from an adversity (Hua, 2018)	CC1: People in my community help each other. CC2: I have friends in my communities. CC3: I have a strong tie in my community.	(Hua, 2018) And author-developed

Question Items				Adapted From / Developed
Family Support	FS	Refers to resources that a family can provide to an individual to respond to and recover from an adversity (Hua, 2018)	FS1: When I face a disruptive event, my family is optimistic in difficult situations FS2: When I face a disruptive event, there are family members who help me FS3: When I face a disruptive event, I have family members who encourage me	(Farnsworth, 2013) and (Hua, 2018)
Psychological Resilience	PR	Refers to an individual's capacity to remain functional by absorbing, recovering from, and adapting to adversity (Hua, 2018)	PR1: I am able to adapt to change. PR2: I tend to bounce back after hardship and can cope with stress PR3: I can achieve goals despite obstacles. PR4: I can stay focused under pressure. PR5: I can deal with whatever comes.	Campbell-Sills (2007) and Stein and Connor and Davidson (2003) by Hua (2018).

Question Items				Adapted From / Developed
Access to Technology	AT	Refers to the Availability of ICT resources (Muriithi et. al, 2016)	AT1: I have access to computer whenever I need it AT2: I have a strong internet connection AT3: I can purchase technology when needed	Kitmitto et. al. (2018) and author-developed
Digital Literacy	DL	Refers to an individual's skills and abilities that enable him or her to adopt and use technology with relative ease (Sun & Jayaraj, 2013)	DL1: I am skilled in using computers. DL 1: I possess the expertise to use information technologies. DL2: I know how to use different information systems.	Sun & Jayaraj (2013)
Self-efficacy	SE	Refers to an individual's judgment of his/her own capability to use a new information technology (Sun & Jayaraj, 2013).	SE1: I could complete a task using technologies if there was no one around to tell me what to do as I go. SE2: I could complete a task using technologies if I could call someone for help if I got stuck. SE3: I could complete a task using technologies if I had	Sun & Jayaraj (2013)

Question Items				Adapted From / Developed
			just the built-in help facility for assistance.	
Perceived Digital Resilience	DR	Refers to an individual being cognitively well-placed to adopt new technologies and accept digital transformation as a way to bounce back from disruptive events. (self-defined)	DR1: Overall, during COVID 19, I am equipped with necessary resources to operate in digital environment. DR2: Overall, during COVID 19, I am mentally able to adapt to digital environment. DR3: I Overall, during COVID 19, I find it is easy to bounce back from disruptive events by operating on digital platforms. DR4: Overall, during COVID 19, I am technically able to adapt to digital environment.	Author-developed

Table 1. Questionnaire items used in the study

4.5. Data Analysis Methods

Statistical software was used to compile and process the data obtained. SmartPLS program was used to perform the statistical analysis. The model was analysed and run using SmartPLS. The PLS approach is suitable for this study as it gives a "better prediction capability and it is

effective in the analysis of a high complexity model" (Vatanasakdakul & Li, 2010). It also provides no need for a normal distribution assumption which comply with the nature of the data collected. Specifically, SmartPLS was used to generate the following results:

- Measurement Model: To test validity and reliability of survey instrument. Includes the construct validity
- Structural Model: To analyse result of predictive model to analyse correlations, leading up to the acceptance or rejection of the proposed hypotheses. Includes R- square values, F-square values and path coefficients.

SPSS software was also used to generate the following:

- Descriptive Analysis: Demographic information and preferred way of using social commerce.

4.6. Ethical Considerations

Since this analysis requires collecting quantitative data from human subjects, this study obtained ethics approval from Carnegie Mellon University's IRB board prior to the distribution of questionnaires to ensure that the study is conducted ethically.

The questionnaire has been guaranteed the approval of submission (IRB protocol number: 1692761-2). The questionnaire sent out to the participants can be found in the appendix below.

CHAPTER 5. RESULTS

5.1. Introduction

The study's empirical findings are presented in this chapter. Specifically, this chapter will begin by presenting the survey's demographic profiles using descriptive analysis. The results of operational models (Structural model, significance test of path coefficients, direct & indirect influence, and control variables) will then be discussed, along with the evaluation of the measurement model (Content validity, construct validity, loadings & weight, average variance and reliability). Finally, an analysis of the research hypotheses will be conducted, measuring the validity of the proposed hypothesis.

5.2. Descriptive Analysis

5.2.1. Response Rates of Participants

The questionnaire was conducted between the 1st of March to the 1st of April 2021. Participant recruitment emails with a link to the questionnaire was sent to a sample of over 300 users with recipients encouraged to share the survey invitation. 105 valid survey responses were received during this period.

5.2.2. Descriptive Analysis

The descriptive information of the questionnaire respondents is presented in the following tables:

		n	Frequency
Gender	Male	81	76.4%
	Female	24	22.6%
Age	18-19	0	0%
	20-29	15	14.3%
	30-39	30	28.6%
	40-49	46	43.8%

		n	Frequency
	50 years or above	14	13.3%
Nationality	Qatari	35	33.3%
	Expat	70	66.7%
Years living in Qatar	1-5 years	9	8.6%
	6-10 years	21	20%
	11-20 years	27	25.7%
	21-30	19	18.1%
	More than 30 years	29	27.6%
Highest Education	Elementary/Middle School	0	0%
	High School	6	5.7%
	Bachelor Degree	44	41.9%
	Master Degree	43	41%
	PhD	12	11.4%
Occupation	Student	5	4.8%
	Employee/self-employed	98	93.3%
	Unemployed	1	1%
	Retired	1	1%
Income (annual)	Less than 100,000 QR	9	8.6%
	100,000 QR - 200,000 QR	11	10.5%
	200,000 QR - 300,000 QR	11	10.5%
	300,000 QR - 400,000 QR	12	11.4%
	More than 400,000 QR	41	39%
	Prefer not to say	21	20%

Table 2. Descriptive statistics on the demographic

In terms of the study's demographic, the participant pool consisted of 76.4% male and 22.6% female, providing a relative representation of the 3:1 male to female ratio in Qatar (Alrouh et al., 2013). The majority of participants are in the range of 40-49 (43.8%) and 30-39 (28.6%). There were overall fewer participants in the age range of 20-29 (14.3%) and 50+ (13.3%), while there were no participants in the age range 18-19. The pool included 33.3% Qatari participants and 66.7% expats living in Qatar for at least one year. Most of the participants lived in Qatar for more than 30 years (27.6%), 25.7% lived in Qatar for 11-20 years, 20% lived

in Qatar for 6-10 years, 18.1 years lived in Qatar for 21-30 years and 8.6% lived in Qatar for 1-5 years. In terms of education, 41.9% of the respondents held a Bachelor's Degree, followed by Master's (41%), PhD (11.4%) and High School (5.7%). The participants were also asked about their occupation, 93.3% of them were employed/self-employed, 4.8% were students, 1% were unemployed and 1% were retired. As for income, the majority of the participants earn more than 400,000 QR a year (39%), followed by 300,000 QR – 400,000 QR (11.4%), 200,000 QR – 300,000 QR (10.5%), 100,000 QR – 200,000 QR (10.5%) and less than 100, 000 QR (8.6%). 20% of participants, however, preferred not to say.

There were overall fewer participants in the age range of 20-29 (14.3%) and 50+ (13.3%), while there were no participants in the age range 18-19. This might be because the survey was initially distributed to employees through certain Qatari institutions then was snowballed to the general public through these employees. As a result, there were higher numbers of participants holding a Bachelor and Master's degree in terms of education. Likewise, the majority had more than 400,000 QR as annual income. Because most respondents were employed, highly educated and financially stable, the study might be a representative of a sub-population.

5.2.3. Shifting to Online During COVID-19

		n	Frequency
Banking preference before covid-19	In-person	15	14.3%
	Online	90	85.7%
Banking during Covid-19 lockdown	Waited for banks to reopen	9	8.6%
	Shifted to online	96	91.4%
Banking now	In-person	8	7.6%
	Online	97	92.4%
Shopping preference before covid-19	In-person	70	66.7%
	Online	35	33.3%
Shopping during Covid-19 lockdown	Waited for shops to reopen	37	35.2%
	Shifted to online	68	64.8%
Shopping now	In-person	59	56.2%
	Online	46	43.8%
Current work/study	In-person	49	46.7%

		n	Frequency
	Online	16	15.2%
	Hybrid	40	38.1%
Shift to digital environment	Easy	48	45.7%
	Neutral	39	37.1%
	Challenging	18	17.1%

Table 3. Descriptive statistics on shifting online during COVID-19

To better understand an individual's digitally resilient behaviour during a disruptive life event, participants were asked about their preferred mean of banking and shopping. Likewise, they were asked about their experience with the shift to online platforms during COVID-19. As can be deduced from the table, 85.7% of the participants prefer online banking and only 14.3% prefer banking in-person. As a result, 91.4% of participants shifted to online banking during COVID-19 lockdown while 8.6% waited for banks to reopen. Post lockdown, 92.4% are still banking online while 7.6% returned to in-person banking. The results clearly show an increased adoption in online banking due to COVID-19 lockdowns, while there was a relatively huge initial interest in online banking to begin with. These results coincide with De' et al. (2020) argument that the surge in information technology usage during and post the pandemic are effects of a digital transformation already underway before the pandemic set in, and it will take form as a result of the lockdowns.

As for shopping, only 33.3% of the participants prefer online shopping and 66.7% prefer shopping in-person. Nonetheless, 68% of participants shifted to online shopping during COVID-19 lockdown while 35.2% waited for shops to reopen. Post lockdown, 43.8% are still shopping online while 56.2% returned to in-person shopping. Although online banking is more favored, this is not the case with online shopping. As the results show, people adopted online shopping only during lockdown exhibiting a massive change in usage patterns and usage behaviour. People are adjusting to new "normal" at the time of the lockdown with new emerging patterns of daily activities. The changes have also come suddenly, with barely any time for people and even stores to plan for, prepare and implement new setups and arrangements; they have had to adjust, try, experiment, and find ways that did not exist before (De' et al., 2020). Hence, it could be concluded that IT adoption has some a clear connection with digital resilience is the adoption of online banking before COVID-19 encouraged more

people to use online banking during lockdown and continue using it post lockdown. While, the relatively lower adoption of online banking before COVID-19 resulted in more participants going back to in-person shopping post lockdown even after the high increase of percentage of participants shifting to online shopping during lockdown.

Out of the 105 participants, 46.7% are working/studying in-person, followed by 38.1% hybrid and 15.2% working/studying remote. The majority of participants found the shift to the online environment easy (45.7%) while 37.1% found it neutral and 17.1% found it challenging.

5.3. Evaluation of Measurement

5.3.1. Construct Validity

5.3.1.1. Loadings and weight

The results shown here are reflective indicators. The bootstrapping results was generated using SmartPLS to generate the PLS loading, T-statistics and weight value. A study by Chin (1988) highlights how the loading value found should be greater than 0.707. Furthermore, the T-statistics for each path coefficient should be > 1.645 at 0.05 significance level and > 2 at 0.01 significance level. The weight of each indicator is also listed to support the analysis, allowing us to determine how much the indicator contributes to the construct (Vatanasakdakul, 2007).

Construct and Items	PLS Loading	T Statistics	Significant level
Community Capital			
CC1	0.814	9.633	0.01
CC2	0.873	12.153	0.01
CC3	0.820	7.965	0.01
Family Support			
FS1	0.878	12.717	0.01
FS2	0.934	36.378	0.01
FS3	0.863	14.298	0.01
Psychological Resilience			

Construct and Items	PLS Loading	T Statistics	Significant level
PR1	0.725	7.313	0.01
PR2	0.759	10.802	0.01
PR3	0.845	15.192	0.01
PR4	0.772	11.708	0.01
PR5	0.801	13.577	0.01
Access to Technology			
AT1	0.903	22.422	0.01
AT2	0.932	30.012	0.01
AT3	0.807	10.486	0.01
Digital Literacy			
DL1	0.893	14.476	0.01
DL2	0.964	68.591	0.01
DL3	0.896	23.858	0.01
Self-Efficacy			
SE1	0.747	9.719	0.01
SE2	0.898	26.408	0.01
SE3	0.913	26.726	0.01
Digital Resilience			
DR1	0.869	14.886	0.01
DR2	0.854	18.903	0.01
DR3	0.906	33.494	0.01
DR4	0.901	27.082	0.01

Table 4. Loading values

Construct and Items	PLS Loading	T Statistics	Significant level
Community Capital			
CC1	0.381	3.869	0.01
CC2	0.398	3.792	0.01
CC3	0.417	3.408	0.01

Construct and Items	PLS Loading	T Statistics	Significant level
Family Support			0.01
FS1	0.348	4.383	0.01
FS2	0.404	5.904	0.01
FS3	0.367	5.509	0.01
Psychological Resilience			
PR1	0.232	4.385	0.01
PR2	0.263	5.327	0.01
PR3	0.296	8.504	0.01
PR4	0.236	5.846	0.01
PR5	0.250	4.876	0.01
Access to Technology			
AT1	0.406	6.453	0.01
AT2	0.376	9.573	0.01
AT3	0.351	4.469	0.01
Digital Literacy			
DL1	0.346	12.113	0.01
DL2	0.371	16.431	0.01
DL3	0.372	10.947	0.01
Self-Efficacy			
SE1	0.338	4.547	0.01
SE2	0.425	10.920	0.01
SE3	0.400	8.608	0.01
Digital Resilience			
DR1	0.274	14.275	0.01
DR2	0.275	11.958	0.01
DR3	0.273	11.009	0.01
DR4	0.311	10.894	0.01

Table 5. Model weight

According to the loading value table, the condition of loading scores as suggested by Chin (1998) were met in the study. Firstly, all loading results were higher than 0.707. All Cronbach alpha scales were also above the 0.7 threshold, meeting the threshold for valid internal consistency. Furthermore, all AVE scales exceeded 0.5 for all items, with the lowest being PR (Psychological Resilience) (0.611) and the highest being DL (Digital Literacy) (0.843).

5.3.1.2. Cross Loadings

The table below displays the results of the cross-loading procedure by SmartPLS. The results indicate good loading amongst construct variables. Each indicator shows higher values when compared with other corresponding latent variables, meaning that each block had a higher loading than any other compared to adjacent blocks. This shows that the loading values separate each latent variable, confirming the validity of the results.

	Access to Technology	Community Capital	Digital Literacy	Digital Resilience	Family Support	Psychological Resilience	Self-Efficacy
AT 1	**0.903**	0.336	0.54	0.595	0.394	0.422	0.337
AT 2	**0.932**	0.316	0.565	0.551	0.423	0.501	0.403
AT 3	**0.807**	0.327	0.597	0.515	0.485	0.505	0.414
CC 1	0.395	**0.814**	0.291	0.332	0.48	0.345	0.179
CC 2	0.293	**0.873**	0.22	0.225	0.479	0.36	0.141
CC 3	0.246	**0.82**	0.305	0.266	0.461	0.377	0.243
DL 1	0.579	0.288	**0.893**	0.66	0.46	0.421	0.632
DL 2	0.587	0.317	**0.964**	0.707	0.405	0.487	0.689

	Access to Technology	Community Capital	Digital Literacy	Digital Resilience	Family Support	Psychological Resilience	Self-Efficacy
DL3	0.6	0.291	**0.896**	0.708	0.373	0.478	0.667
DR1	0.616	0.357	0.644	**0.868**	0.484	0.534	0.48
DR2	0.463	0.229	0.66	**0.855**	0.383	0.535	0.617
DR3	0.506	0.2	0.615	**0.906**	0.355	0.567	0.583
DR4	0.632	0.36	0.735	**0.901**	0.47	0.592	0.619
FS1	0.415	0.505	0.332	0.421	**0.878**	0.393	0.337
FS2	0.499	0.555	0.489	0.507	**0.934**	0.456	0.461
FS3	0.391	0.453	0.368	0.35	**0.863**	0.413	0.281
PR1	0.341	0.241	0.431	0.518	0.297	**0.73**	0.325
PR2	0.4	0.345	0.371	0.509	0.376	**0.759**	0.279
PR3	0.528	0.422	0.464	0.545	0.428	**0.844**	0.361
PR4	0.377	0.278	0.329	0.466	0.355	**0.772**	0.251
PR5	0.434	0.386	0.364	0.425	0.381	**0.799**	0.281
SE1	0.334	0.029	0.652	0.484	0.197	0.237	**0.747**
SE2	0.389	0.247	0.578	0.61	0.44	0.397	**0.898**
SE3	0.388	0.277	0.641	0.574	0.383	0.342	**0.913**

Table 6. Cross loading table

5.3.1.3. Average Variance Extracted

A study by Fornell and Larcker (1981) shows how discriminant validity can be confirmed through the comparison of AVEs of latent variables and latent variable correlation. The study suggests that AVE of latent variables should be higher than the squared value of latent variable correlation. This establishes how the square root of AVE values found in the statistical outcomes should be greater than its corresponding diagonal variables; Table shows that the square rooted values of the AVE are greater than its diagonal variables, confirming the discriminant validity in this study.

	Access to Technology	Community Capital	Digital Literacy	Digital Resilience	Family Support	Psychological Resilience	Self-Efficacy
Access to Technology	**0.882**	0	0	0	0	0	0
Community Capital	0.37	**0.836**	0	0	0	0	0
Digital Literacy	0.641	0.325	**0.918**	0	0	0	0
Digital Resilience	0.63	0.327	0.754	**0.883**	0	0	0
Family Support	0.489	0.566	0.448	0.48	**0.892**	0	0
Psychological Resilience	0.537	0.432	0.504	0.632	0.473	**0.782**	0
Self-Efficacy	0.433	0.226	0.723	0.653	0.407	0.386	**0.856**

Table 7. Correlation of latent constructs

5.3.2. Reliability

As stated by Cronbach (1971), the reliability of a study needs to be tested to validate consistency between measurements, which includes internal consistency. Cronbach values suggests how the scales should be above the 0.7 threshold for valid internal consistency. Additional factors were also included test reliability, including:

1. **PLS-loadings:** PLS-loading values are used to measure the reliability for each variable in the proposed model. (Chin, 1998; Vatanasakdakul, 2007; Defiandry, 2020).
2. **Composite Reliability:** The composite reliability is used to measure the reliability for the mode's constructs. (Vatanasakdakul, 2007; Defiandry, 2020).
3. **AVE (Average Variance Extracted):** The AVE value is used to measure the validity and reliability of the generated results (Fornell & Larcker, 1981; Vatanasakdakul, 2007; Defiandry, 2020).

The results for the aforementioned reliability assessments are shown in the following table:

Construct and Items	PLS Loading	T Statistics	Significant level	Cronbach's Alpha	Composite Reliability	AVE
Community Capital				0.784	0.874	0.699
CC1	0.814	9.633	0.01			
CC2	0.873	12.153	0.01			
CC3	0.820	7.965	0.01			
Family Support				0.871	0.921	0.796
FS1	0.878	12.717	0.01			
FS2	0.934	36.378	0.01			
FS3	0.863	14.298	0.01			
Psychological Resilience				0.84	0.887	0.611
PR1	0.725	7.313	0.01			
PR2	0.759	10.802	0.01			
PR3	0.845	15.192	0.01			

Construct and Items	PLS Loading	T Statistics	Significant level	Cronbach's Alpha	Composite Reliability	AVE
PR4	0.772	11.708	0.01			
PR5	0.801	13.577	0.01			
Access to Technology				0.855	0.913	0.778
AT1	0.903	22.422	0.01			
AT2	0.932	30.012	0.01			
AT3	0.807	10.486	0.01			
Digital Literacy				0.906	0.942	0.843
DL1	0.893	14.476	0.01			
DL2	0.964	68.591	0.01			
DL3	0.896	23.858	0.01			
Self-Efficacy				0.814	0.891	0.733
SE1	0.747	9.719	0.01			
SE2	0.898	26.408	0.01			
SE3	0.913	26.726	0.01			
Digital Resilience				0.905	0.934	0.779
DR1	0.869	14.886	0.01			
DR2	0.854	18.903	0.01			
DR3	0.906	33.494	0.01			
DR4	0.901	27.082	0.01			

Table 8. Reliability assessment

Results in Table shows that all Cronbach Alpha values for the models were above the 0.7 threshold for acceptance (Cronbach, 1971; Defiandry, 2020). For an item to be considered as reliable, a minimum of 0.7 loading value is needed to ensure that the measurer is 'accounted for by the respective construct' (Vatanasakdakul, 2007; Defiandry, 2020). Furthermore, Chin (1998) indicates that the composite reliability values generated through SmartPLS are suitable to measure internal consistency. All of the composite reliability values are greater than 0.7, which signifies validity above the minimum value for composite reliability (Vatanasakdakul,

2007; Defiandry, 2020). The third variable, the Average Variance Extracted (AVE) scales should all exceed 0.5 to show that 50% of the indicators are accounted for (Chin, 1998; Vatanasakdakul, 2007; Defiandry, 2020). As seen in Table above, all of the AVE scales exceed 0.5, meaning that the AVE scales have met the standards of accountability. Through this reliability assessment, it was shown that all the constructs (Composite reliability, AVE and Cronbach Alpha) values were valid and verified.

This section has tested and validated the construct validity and reliability. Through this, the integrity of the structural model and its analysis in the next sections are confirmed. The next section will proceed with data analysis, using the results of the operational model as its basis.

5.4. Operational Model Results

This section shows PLS estimates from the operational model created in this study. Based on the output of the structural model, the model as a whole will be evaluated. Furthermore, this section will present significance tests and the resultant hypothesis testing based on the structural model.

5.4.1. Structural Model

An overview of the structural model result (showing cross loading values and path coefficients) is shown in Figure 3. The following section presents the interpretation of this generated result.
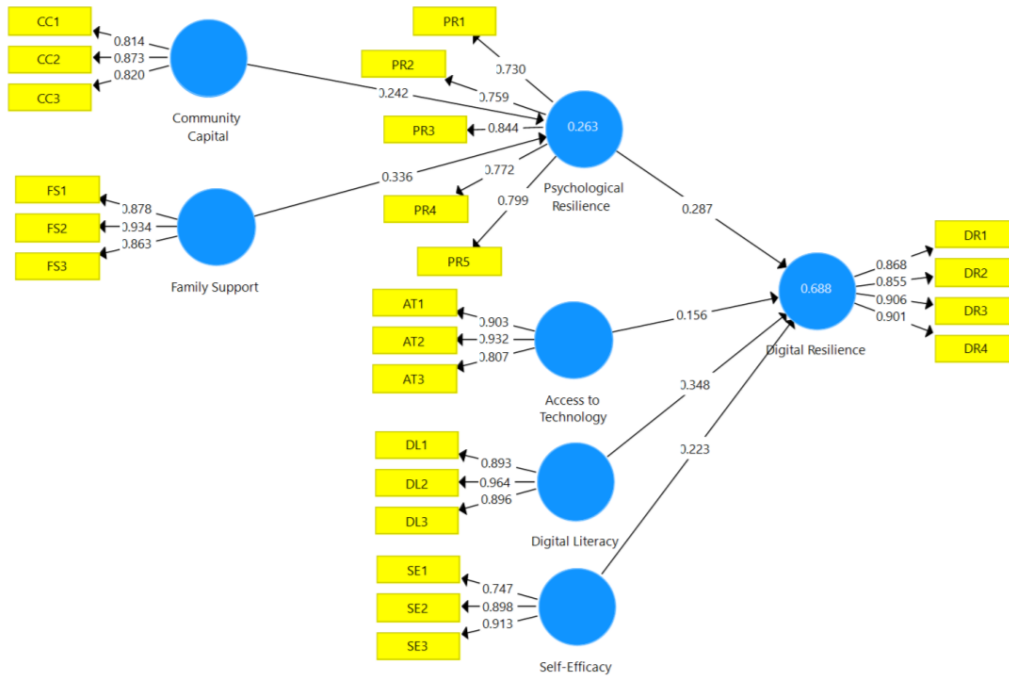
Figure 2. Structural Model Results

5.4.2. R-square

The R-square value of the study's dependent variables provides the predictiveness of a model. According to Vatanasakdakul (2007), this value indicates the extent in which independent constructs predict dependent constructs. Essentially, the higher the R-square value is, then the more predictive power the model provides. The R-square of 0.263 (0.249 for R-square adjusted value) of digital resilience suggests how the psychological resilience variable accounts for 26.3% of construct variance.

5.4.3. F-square Values

The F-square values generated through PLS can be used to predict how much effect an independent construct has on the dependent (Vatanasakdakul, 2007; Defiandry, 2020).

Construct	F-square	Degree of Effect
Access to Technology	0.041	small effect
Community Capital	0.054	small effect
Digital Literacy	0.131	small effect

Construct	F-square	Degree of Effect
Family Support	0.104	small effect
Psychological Resilience	0.176	medium effect
Self-Efficacy	0.076	small effect

Table 9. F-square values

Results from the F-square value testing revealed that the factors of access to technology, community capital, digital literacy, family support, psychological resilience, self-efficacy had effects on digital resilience. As suggested by Cohen & Cohen (1983), an F-square value of 0.02 shows a small effect, an F-square value of 0.15 shows a medium effect, while an F-square value of 0.35 presents a large effect. Thus, the aforementioned factors present a small effect on digital resilience.

5.4.4. Path Coefficients

In the structural model, the path coefficient values indicate the link amongst variables. All of the variables are connected in a way that resembles the proposed model and the path coefficients between variables are standardised to 'permit comparison of their relative strengths' (Vatanasakdakul, 2007; Defiandry, 2020). To generate these values, a bootstrapping analysis was conducted using SmartPLS.

Table presents the statistical outcomes, examining each of the hypotheses proposed in this study. The statistics generated through PLS bootstrapping (including actual effect, path coefficient, standard deviation, observed t-statistics, and p values) is included.

Impact on Digital Resilience	Actual Effect	Path Coefficient	Standard Deviation	T Statistics	Significance
Access to Technology	+	0.156	0.109	1.422	**90%**
Community Capital	+	0.242	0.131	1.845	**95%**
Digital Literacy	+	0.348	0.105	3.32	**99%**
Family Support	+	0.336	0.103	3.272	**99%**

Impact on Digital Resilience	Actual Effect	Path Coefficient	Standard Deviation	T Statistics	Significance
Psychological Resilience	+	0.287	0.089	3.237	99%
Self-Efficacy	+	0.223	0.111	2.005	95%

Table 10. Summary of path coefficients test

According to Chin et al. (2003), the path coefficients should have t-value of more than 1.282 for a significance level at 0.1 (90%), more than 1.645 for a significance level at 0.05 (95%) and more than 2 for a significance level at 0.01 (99%).

Model Construct	Research Hypothesis	Result
Psychological Resilience	H1: Psychological resilience has a positive relationship with perceived digital resilience.	Accept
Community Capital	H2: Community capital has a positive relationship with building psychological resilience.	Accept
Family Support	H3: Family support has a positive relationship with building psychological resilience.	Accept
Access to Technology	H4: Access to technology has a positive relationship with perceived digital resilience.	Accept
Digital Literacy	H5: Digital literacy has a positive relationship with perceived digital resilience.	Accept
Self-Efficacy	H6: Self-efficacy has a positive relationship with perceived digital resilience.	Accept

Table 11. Summary of hypothesis results based on the structural model

This section made some conclusions on the research hypotheses based on the summary of path coefficient test and hypothesis results. Chapter 6 will explore these hypotheses further and

discuss the implications these results have on the factors influencing digital resilience in individuals.

5.5. Conclusion

In this study, PLS was used to analyse the correlation between the model's constructs to digital resilience. Furthermore, access to technology, community capital, digital literacy, family support, psychological resilience and self-efficacy were shown to have a significant impact on digital resilience. In particular, digital literacy was found to have the highest impact on digital resilience suggesting the importance of digital skills and knowledge in influencing digital resilience in an individual. Furthermore, access to technology was found to have minimum, yet present impact on digital resilience and was found to be the least important factor in influencing digital resilience in an individual.

In conclusion, this chapter identifies specific variables from the theories of psychological resilience and IT adoption theories to be the primary factors influencing digital resilience. The next chapter will focus on the key contributions that these results bring along with the discussion of research implications.

CHAPTER 6. DISCUSSION

6.1. Introduction

This chapter discusses the findings of the research based on the data analysis and hypothesis result testing shown in chapter 5. It analyses how findings contribute to the research objectives and existing literature.

6.2. Discussion of Structural Model

This section aims to analyse the research question: "What factors influence perceived digital resilience among individuals in Qatar?" This research developed a model used to investigate the factors affecting digital resilience among individuals. The proposed model adopted the psychological resilience construct from Hua et. al (2018) Model of Economic Resilient Behavior Model. In order to justify the digital dimension of digital resilience, the study investigated existing IT adoption models and derived self-efficacy and digital expertise (digital literacy) from Technology Adoption and Continuance Model by Sun and Jeyaraj (2013), and derived access to technology from the revisited Technology Acceptance Model by Musa (2006). These variables have then been adapted into the digital resilience context. Questionnaire items in this study asks participants about relationships in their community and family, their psychological attitudes during disruptive life events, their skills and knowledge of using different information technologies and their overall attitude during COVID-19.

When it comes to psychological resilience and its relationship to digital resilience, the findings of this study are consistent with speculations of previous studies. Psychological resilience was found to be a substantial factor of digital resilience among individuals, therefore the findings confirm Hua et al.'s (2018) model construct which the proposed model is based on. Hua et al. reveal that there is a strong relation between an individual's metal state and his or her resilience capability. Hence, this proposed model derives from the theory of "psychological capacity of resilience". Prior research found that the psychological capacity of resilience enables an individual to properly adapt to stress and adversity and that psychological resilience is not a trait and can be developed in processes (Lyon & Parkins, 2013). In general, people with positive emotionality are more likely to demonstrate resilience because they know how to balance

negative and positive emotions. People with higher resilience can more easily navigate themselves around stress and adversity, stay positive, and pursue resilient outcomes (Frederickson et. al, 2003).

Fear appeals, according to Hua et al. (2018), influence an individual's ability to be resilient in the same way as positive or negative feelings influence his or her ability to take resilient actions and decisions. Fear appeals heighten a person's fear and concern about a danger, suggest practical solutions to mitigate the threat, and emphasize the value of the solutions. Fear appeals that work will persuade an individual that the danger is real, dangerous, and probable. If the individual does nothing, he will be in grave danger. As a result, Hua et al. (2018) argue that fear can cause users to alter their actions in order to reduce the risk's effect.

Zooming in into the Qatari context, existing literature found that psychological resilience was a coping mechanism in Qatar during the blockade (El-Masri et al., 2020). Qatar residents experienced an emotional roller coaster during the blockade, they used positive emotions like love and optimism to cope with adversities and accompanying emotions of fear and anger. Hence, the adaptive resilient capacities of people living in Qatar gradually strengthened during the nine months of blockade (El-Masri et al., 2020). Consistent with the assertions and findings in the relevant literature, our findings reveal that building individual resilience transpires through the constant and gradual adaptation to stressful events using psychological. Similarly, in the context of the digital space, existing psychological resilience capabilities in an individual builds digital resilience as it provides individuals with the cognitive ability to adapt to new technology and change their lifestyle to adapt to digital transformations.

As for community capital and its relationship to psychological resilience, the findings of this study are steady with speculations of previous studies. Community capital was found to be a present factor of psychological resilience. However, the findings extend Hua et al.'s (2018) argument by showing that community capital is the weaker factor that constitutes to psychological resilience. According to t-statistics calculated in this study, community capital poses weaker, but still present, effects on psychological resilience compared to family support.

According to the relevant literature, when individuals face disruptive and adverse events, they will worry about their savings and daily routines (Hua et al., 2018). Community capital can be

considered as a protective factor for people's psychological health, a critical factor in psychological resilience (Dumont & Provost, 1999). Past research also found strong community capitals may help individuals handle their temporary financial difficulty and provide needed emotional support, legal counsel, and other forms of assistance. Through these community resources, individuals develop better capability to deal with the stress and adversity caused by disruptive and sudden events and better adapt to the situation.

Although prior studies emphasize the importance of community capital on psychological resilience development, this study found that, in the context of Qatar, community capital plays a minimal role compared to family support. A possible reason for this is that Qataris are considered a 'minority' in their own nation with only 15% of them accounting for Qatar's total population. The remaining 88% is made up of a workforce of over a hundred different nationalities (OnlineQatar, 2019). Given that, the reflections in this study on the community bonds in Qatar mostly captured expats' opinions than the locals' opinions since most of the study participants were expats. Expats' sense of community in Qatar might not be strong as they might feel left out, feel like they are outsiders and feel like they don't fit in. They might feel embarrassed to ask for support from the Qatari community. Likewise, they might not have the same privileges and community resources as the Qataris. Hence, community capital might be limitedly significant in developing psychological resilience compared to family support.

As for family support and its relationship to psychological resilience, the findings of this study are consistent with speculations of previous studies. Family support was found to be a substantial factor in developing psychological resilience. However, the findings extend Hua et al.'s (2018) argument by showing that family support is a more dominant factor of psychological resilience. According to t-statistics calculated in this study, family support has a much more significant effect on psychological resilience compared to community capital.

Existing studies show that people with high family support are generally, more resilient and able to better cope with stress and adversity in their life (Hua et al. 2018). This is because family support encompasses emotional support; family act as a backbone during stressful times enabling an individual to survive difficult times (Norris et al. 2008). Not only that, but family resilient characteristics can influence an individual's psychological resilience since that

individual will adopt resilient habits from his or her family. conversely, family-level resources, especially financial resources during adverse times are strongly associated with an individual's resilience (Ali et al. 2010). According to Hua et al. (2018), family structures is argued to influence family members action more rapidly leading to more resilient individuals.

This can be seen in the context of Qatar as well. Studies have shown that family structures have long played a key role in the care and well-being of individuals in the Arab world and has been position as the basic unit of society (Kronfol et al., 2016). Family bonds and ties is a huge part of the Qatari culture and is immensely sacred. Not only is family bond valued among locals, the expatriate community in Qatar also value family bonds and ties. This is because expats might not relate to the broader community, they might feel detached from Qataris. Hence, flee to their families for support, especially financial support. Expats may prefer connections with their family instead of the broader community since they can relate to their families in terms of culture, language, interests and most importantly their families might remind them of their home. Moreover, given the COVID-19 situation, the forced social distancing has in one way turned out to have a very positive outcome in the family relations in Qatar (Varghese, 2020). Children who used to be away from family during school hours, and parents who used to be away from family work hours are now finding more time to spend at home and this has resulted in more strengthening of the already strong family bond, both local families and expat families, in Qatar's society. Henceforth, family support had higher effects on psychological resilience than that of community capital in this study.

When it comes to access to technology and its relationship to digital resilience, the findings of this study are steady with speculations of previous studies. Access to technology was found to be a present factor in digital resilience among individuals. However, the findings extend Musa's (2006) argument by showing that access to technology is the weakest factor digital resilience.

Based on the Acceptance Model by Musa (2006), technology acceptance or adoption is ultimately influenced by the application of and exposure of individuals to technology in their daily lives. It is suggested by Musa (2006) that accessibility factors positively correlated to perceived usefulness, ease of use, and behavioral intention to adopt and use IT. Similarly, Porter et. al. (2006) suggests that use of computing technologies is highly dependent on the

support infrastructure. In the context of digital resilience, the more exposed individuals are to technology, the more these individuals are capable to effectively use technology to navigate disruptive times (Budak et al., 2021).

In the context of Qatar, access to technology is taken for granted. Almost everyone living in Qatar is able to access basic technology both financially by purchasing the needed technology during times of stress, and physically accessing needed technology. Free access computers are widely abundant in Qatar in public places such as libraries. Likewise, most public places have free internet access. In terms of infrastructure, Qatar has a strong infrastructure supporting stable internet connection and similarly has reliable electricity making access to technology easy. Not to mention, Qatar has the highest internet penetration rate in the world. Therefore, when it comes to access to technology, it is a least significant factor in the context of this study since most people in Qatar are fortunate to have easy access to technology regardless of their individual circumstances. Our findings extend the notion of access to technology being a prerequisite to its use, proposed by Musa (2006), by indicating that the access to technology factor is mostly relevant among individuals in countries with weaker IT infrastructure and who struggle with accessing IT as a means to cope with adversity.

In terms of digital literacy and its relationship to digital resilience, the findings of this study are steady with speculations of previous studies. Digital literacy was found to be a strong factor of digital resilience among individuals. The findings confirm Sun's and Jeyaraj's (2013) argument by showing that digital literacy is the most influential factor that constitutes to digital resilience among individuals.

According to Sun and Jeyaraj (2013), Inadequacy of digital skills can cause an individual to feel insecure, therefore cause the individual to feel disinclined to use technology. Conversely, the digital skills embodied by individuals affects the way individuals use technology. In the context of digital resilience, in order to effectively use technology to navigate tough times, individuals need to understand how to use the technology correctly. The results of the study also concede with Vandoninck, d'Haenens and Roe's (2013) study which argues that digital literacy levels correlated with greater resilience levels. Higher level of expertise not only allows better utilization of technology during disruptive life events, it also results in familiarization

which should lead to a reduction in technology anxiety and widen the usage of the technology. Hence, ease the shift to the digital space.

However, it is important to note that the digital skills set needed to achieve digital resilience is not generic, it depends on the context of the stressful/disruptive event. Different radical changes in our daily lives impose on people to acquire different literacy in using technologies, it might even require people to acquire literacy to new technology specific to that era or time period. Taking COVID-19 as a case in point, the shift the digital space was mandated by society on short notice. Without prior warnings, employees were expected to work from online, students were expected to study remotely, patients at some point were expected to attend online consultations and the public were expected to conduct daily errands online due to sudden lockdowns. Anecdotally, people shifted online with minimal to no training, or support mechanisms on how to use and apply technology effectively. Zoom and other major online conference platforms are a great example of this. Even though most people have basic computing skills, shifting to Zoom was challenging for many at first. It was tricky conducting university lectures, school classes, meetings and conferences through Zoom while maintaining the same feel and sense of physical meeting rooms. It took time for people to learn their way around it, learn the best method to conduct classes or meetings, learn how to split people into breakout rooms, learn how to share screen and even how to remotely control other's screens.

Resilience technologies might not necessarily align with individuals' previous digital expertise even if these individuals have present digital literacy. Simply having existing digital literacy is not enough to meet the expectations of the era develop digital resilience, the type of digital literacy and expertise is what matters. Developing digital skills relevant to the time period and to the technology needed to survive stressful times is what will help individuals keep up with the stressful change and adapt to it.

As for self-efficacy and its relationship to digital resilience, the findings of this study are consistent with speculations of previous studies. Self-efficacy was found to have significant influence on digital resilience among individuals.

Sun and Jeyaraj (2013) based their self-efficacy construct on Compeau's and Higgins' (1995) theory of Computer Self-Efficacy which is based on Self-Efficacy Theory (SET) proposed by

Bandura (2005) which in turn came from the Social Cognitive Theory. According to Computer Self-Efficacy, the strength of a computer self-efficacy judgment refers to the level of conviction about the judgment, or the confidence an individual has regarding his or her ability to perform digital tasks. Thus, not only would individuals with high computer self-efficacy perceive themselves as able to accomplish more difficult tasks, but they would display greater confidence about their ability to successfully perform each of those behaviors. This confidence is what encourages IT adoption. The more these individuals exhibit a willingness to adapt and change to new situations which in turn affects their resilience in the digital world (Budak et al., 2021).

Although this study agrees with the literature that self-efficacy helps individuals adopt technology during tough times, therefore promotes digital resilience among these individuals, this study contradicts the notion that willingness and acceptance are the drivers of technology adoption. When it comes to self-efficacy, our findings indicate that adoption of technology in the context of the study was made somewhat compulsory. Individuals didn't have much choice during COVID-19 to shift online, the digital space was the only choice. While Compeau's and Higgins' (1995) theory of Computer Self-Efficacy refers to self-efficacy as the "can do" cognition in an individual that boosts willingness indicating that IT adoption is voluntary, this study extends such notion. There is a further dimension to which IT adoption is voluntary or mandatory during disruptive and stressful events. In the case of COVID-19, it was compulsory.

Looking at the context of Qatar, Ehteraz was one of the mandatory technologies used in Qatar to navigate through the COVID-19 pandemic. Ehteraz is an official contact tracing application for the State of Qatar and is owned, operated, and approved by the Ministry of Public Health. ETHERAZ aims to protect and safeguard the health of citizens, residents, and visitors in the State of Qatar to support the national effort in preventing and reducing the spread of COVID-19. The mobile app provides a visual QR code showing infection and/or vaccine status (when available) to other individuals for safe interaction with the wider community. People in Qatar are expected to show the QR code to a security personal before accessing any public place. Failure to show a green QR code prevents people from accessing these places. Likewise, the closing of schools and universities, and the shift to remote learning was mandatory. Neither students nor schools had the opinion to continue in-person classes. Similarly with employees, no one had the choice to work from the office, they were

forced to work from home regardless of whether or not they have the supporting environment at home to do so. Hence, proposing the notion that at times of crisis, individuals don't have the freedom or willingness to adopt technology, they have to adapt to the needs and dynamics of the situation and make the most out of it.

6.3. Conclusion

This chapter focuses on answering the research question: "What factors influence perceived digital resilience among individuals in Qatar?" through discussing study results from the previous chapter. This chapter analyses the research question from the theoretical aspect of the constructs developed for the study, done to pinpoint the most important factors that influence an individual's resilience in a digital space. Amongst the the constructs, digital literacy was found to contribute the most towards digital resilience among individuals. The next chapter will focus on discussing the contributions of this research, its limitations and the implications it has on future research.

CHAPTER 7. CONCLUSION

7.1. Introduction

This chapter provides an assessment of this study's contributions, specifically in regards to the most important factors that influence digital resilience among individuals. Firstly, this chapter highlights the potential contributions of this study, analysed from a theoretical and practical level. Secondly, the limitations of this study are identified, followed by a description on future research implications.

7.2. Research Contribution

This study presents an in-depth investigation of the most important factors influencing digital resilience among individuals. It seeks to show how certain socio-technical factors influence the extent to which an individual develops resilience in a digital context. While the result analysis in the previous chapters have answered the research question in the Qatari context, this section will focus on summarizing its main theoretical contributions and how these points can be applied on a practical level.

7.2.1. Theoretical Contribution

This study sets out to contribute to the literature literature of digital resilience in numerous ways. The review of literature indicates that there has been very limited study of digital resilience from a human perspective (Kohn, 2020). Much of the previous research has attempted to investigate digital resilience at a community level or an organizational level, with a focus on the technical perspective of digital resilience. This study highlights the factors influencing digital resilience from a human perspective at an individual level. It is one of the first studies that considers socio-technical factors, particularly in the context of Qatar. This research was motivated by the gap between the theoretical claims for digital resilience in western societies and organizations. This study has demonstrated empirically that community capital, family support, psychological resilience, digital literacy and self-efficacy impacts an individual's ability to develop resilience in the digital context, thus filling some of the

knowledge gap in explaining what factors influence digital resilience from a socio-technical perspective.

The study started with three models derived from psychological resilience and IT adoption literature (Hua et al, 2018; Sun & Jeyaraj, 2013; Musa, 2006) and ended with a more comprehensive conceptual model. Given the psychological resilience theory by Hua et al. (2018), the findings of this extend this understanding by indicating that family support has a much stronger influence on psychological resilience than community capital in the context in Qatar. Similarly, the model extends the notion of acceptance as a driver of IT adoption. While the two IT adoption models (Sun & Jeyaraj, 2013; Musa, 2006) suggest that an individual's high self-efficacy, high digital literacy and high access to technology increase that individual's confidence and comfortability in using technology. Hence, this increases acceptance and willingness to adopt technology. While this notion is true, it doesn't always apply during chaotic times. Desperate times call for desperate measures and sometimes the only solution is shifting to the digital space, even if individuals are not accepting of technology yet. Thus, there is a further dimension to which IT adoption is voluntary or mandatory during disruptive and stressful events. In the case of COVID-19, it was mandatory.

7.2.2. Practical Contribution

The results of this study provide a deeper understanding of the relationship between psychological resilience capacity, IT adoption and digital resilience. The applicability of this study's findings is not only beneficial to individuals but also for country governments and strategic planning who are working on fostering readiness among individuals.

For practical contributions to Qatar, findings of this study provide additional input and analysis of factors influencing digital resilience among individuals, particularly from the socio-technical perspective. In a national level, findings of this study will benefit the Qatari government in making improvements to Qatar's Digital Transformation Acceleration objectives and plans (Dun et al., 2013). Specifically, the proposed, and empirically tested, research model could be used to evaluate perceived digital resilience among individuals. Likewise, the model could help highlight important socio-technical factors that foster digital resilience in individuals which could be used by the Qatar government to promote digital

resilience among individuals in Qatar. This coincides with Qatar's objective is to empower the Qatari workforce and raise the level of digital readiness in all sectors.

This study also contributes on an organizational level. Organizations and institutions in Qatar could benefit from such a study by promoting digital resilience among employees and preparing them for unexpected times. This could be achieved through providing employees training programs to nourish the highlighted factors found to influence digital resilience among individuals. Likewise, organizations could better prepare for chaotic times by having back up plans for working online considering the heighted factors in the finds of this study. Not to mention prepare risk management protocols and procedures, and create support mechanisms for employees based on the findings of this study.

Most importantly, this study has practical contributions to Qatar in an individual level. The findings of this study highlight important factors that individuals should foster within themselves to achieve high level of perceived digital resilience. For instance, individuals could engage more with existing infrastructure, and develop their digital literacy in anticipation of unpredictive and disruptive times. Nourishing such skills will allow individuals to adapt better when calamity hits. In a similar vein, this study could open eyes and make people more aware of the importance of psychological factors when developing digital resilience. Individuals can support one another, build stronger bonds within their community and get closer to their families in order to promote psychological resilience capacity in themselves and in others.

7.3. Limitations

There are numerous limitations in this study. Firstly, this study is significantly limited in terms of the number of participants and response rate. While questionnaire invites were sent to a sample of over 300 users, only 105 valid responses were recorded for the study. The small sample size of the results provides less statistical reliability and significance, which can be improved by a larger sampling in future studies.

Secondly, subjects of this study were representatives of a sub-population. Due to IRB restrictions, this study was only able to distribute surveys to participants through established

institutions. Given the data collection design of the study, most of the participants were employees of the institutions that distributed the survey on this study's behalf. This might have affected the results since employees are usually more educated, have better experience using technology and earn more compared to the general public. The descriptive analysis conducted in this study shows that almost 52.4% (Master's and PhD combined) of the participants hold post-graduate degrees. For a sample size of 105 responses, it is unusual to have large number of people holding post-graduate degrees in a general population. Thus, the results of the study might have mostly captured the opinions of employees in Qatar instead of the wider community.

Similarly, the participants of the study are mostly expats. There were only a few Qatari nationals who participated in this study. This might have influenced the results since the Qatari mindset might be different compared to expats. A possible reason for the study attracting more expat participants might be because there was only an English version to the survey.

Finally, this research has did not consider how Qatar's culture fits into the development of successful resilience in the digital context. While this study has analysed digital resilience from a behavioral perspective, the differing cultural norms and practices between Qataris and expats may influence how an individual develops digital resilience. The integration of cultural variables in this model will help in providing a more in-depth explanation on the most important factors influencing digital resilience.

7.4. Implications on Future Research

The descriptive and structural model results have provided numerous insights to the most important factors influencing digital resilience among individuals. However, further replications of this study are required to validate the findings of the thesis. Future research can extend on this study in numerous ways. Firstly, the small sample size provides less statistical power. Likewise, as seen in Ch5, most of the participants were employees aged 30-50. Chin (2006) asserts that this can cause the low predictive power (R-square) of the structural model of this study. Thus, one fruitful direction for future research would be to replicate this study with another larger and more diverse sample.

Secondly, future research could modify the data collection design to include a wider representation of the population in Qatar. Future research could develop alternative strategies for data collection and for broader and more diverse sampling, in institutions and in the community at large. Likewise, future research could consider having both an English and Arabic version of the survey to include as much local participants as possible.

Thirdly, further research can modify the proposed research model and dimensions developed for this study. Results from this study shows that only psychological factors and IT adoption factors influence digital resilience among individuals. Future studies can use this proposed model and dimensions as a foundation and redefine it based on the culture and region they want to analyse. A factor that may be beneficial for future studies is the cultural dimension of the country itself.

Fourthly, since the digital literacy and psychological resilience were found to have the most significant influence on the individual's digital resilience, future research should focus on studying these constructs further. This can be done through including additional variables in these dimensions to investigate other factors that can potentially influence digital resilience.

7.5. Concluding Remarks

In summary, this thesis acts as the first step in investigating the most important factors influencing an individual's resilience in a digital context. By exploring socio-technical factors borrowed and adapted from psychological resilience and IT adoption literature, this study has contributed significantly in both a theoretical and practical level. Nevertheless, there are some limitations related to the unit of analysis, response rate and the measuring of secondary order factors. Hence, this thesis suggests that future research can be conducted by replicating this study in other contexts, modifying the current model and extending the analysis by comparing different firm sizes.

It is important to continue exploring the domain of digital resilience given it has been a key enabler of many societies during stressful and disruptive times. Taking the COVID-19 pandemic as a case in point, almost all of the world's operations had to shift online to meet the contactless demand of the era. When human contact was considered a life threat, nations all over the world were tested for their digital resilience and their ability to continue operating in

the digital space. Given the importance of digital resilience in this era and the future to come, this domain deserves more research attention. In order to fully depend on the digital space in times of need, we have to know how things operate.

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9. APPENDICES

APPENDIX A: COLLINEARITY STATISTICS (VIF)

Outer VIF Values

	VIF
AT1	3.087
AT2	3.671
AT3	1.670
CC1	1.640
CC2	1.962
CC3	1.537
DL1	3.369
DL2	6.026
DL3	3.076
DR1	2.550
DR2	2.447
DR3	3.389
DR4	3.121
FS1	2.478
FS2	3.244
FS3	2.059
PR1	1.597
PR2	1.595
PR3	2.176
PR4	1.808
PR5	1.920
SE1	1.398
SE2	2.660
SE3	2.882

Inner VIF Values

	Access to Technology	Community Capital	Digital Literacy	Digital Resilience	Family Support	Psychological Resilience	Self-Efficacy
Access to Technology				1.906			
Community Capital						1.472	
Digital Literacy				2.969			
Digital Resilience							
Family Support						1.472	
Psychological Resilience				1.501			
Self-Efficacy				2.106			

APPENDIX B: PARTICIPANT RECRUITMENT & QUESTIONNAIRE

Dear Sir/Madam,

This email is being sent on behalf of Yara Al-Abdulghani, a Senior Honors Thesis student in the Information Systems Program at Carnegie Mellon University in Qatar (CMU-Q) in Education City. This research is being supervised by her CMU-Q Faculty Advisors, Dr. Savanid Vatanaksadakul and Dr. Chadi Aoun.

What is this research about?

The title of her research is: *"Exploring Resilience in The Digital Age, A Behavioral Perspective with Qatar as A Case Study."* The purpose of the study is to investigate factors that enable individuals to create successful resilience in the digital space. The research is looking at what factors influence the perceived readiness of digital resilience among individuals, in the context of Qatar. Digital resilience refers to implementing and using information technologies to recover and move forward when faced with challenges. To learn more about the study, please read the attached Project Information Sheet.

Why is this research important?
This research could help to better understand what is required for individuals to become more digitally resilient, able to adjust to dependence on technology and to create a new norm in the digital space. Preparation for and adjustment to this new norm has become even more important due to the impact of COVID-19 on our daily lives.

Who is eligible to participate?
-18 years or older
-Qatari citizen or resident currently residing in Qatar for 1 year or more
-Able to read, speak and write in English

How to take the survey if interested in participating?
-Click the below web link to access the short, online survey.
-Survey estimated to take about 10-15 minutes of your time.
-Also, you are invited to forward this email to any others in Qatar whom you think might be interested in taking this survey to contribute to this Senior Honors Thesis research study.

Right to Ask Questions & Contact Information

Your participation is voluntary. You are free to stop participation at any point. Choosing to not to take the survey or stopping the survey at any point will not result in any penalty or loss of benefits or rights to which you might otherwise be entitled. If at any time during the study you have concerns or questions, you can contact the Senior Honors Student Principal Investigator, Yara Al-Abdulghani by phone (5010-0999) or email (ynabdulg@andrew.cmu.edu) and/or her Faculty Advisors. If you have questions pertaining to your rights as a research participant, or

to report concerns to this study, you can also contact the CMU-Q IRB by email (cmuq-irb@qatar.cmu.edu) or by phone 4454-8669.

http://cmu.ca1.qualtrics.com/jfe/form/SV_1AkyCjcn1kVWJdr

Thank you for considering taking this research survey, and also for forwarding this email to any others in Qatar who might be interested in participating.

Best regards,
Yara Al-Abdulghani (ynabdulg@andrew.cmu.edu)
Savanid Vatanaksadakul (svatanas@qatar.cmu.edu)
Chadi Aoun (chadi@cmu.edu)

Online Survey

This survey is part of an undergraduate Senior Honors Thesis research project being conducted by Principal Investigator, Yara Al-Abdulghani under the supervision of her Faculty Advisors Dr. Savanid Vatanaksadakul and Dr. Chadi Aoun at Carnegie Mellon University in Qatar (CMU-Q) in Education City.

Purpose of this Study

The purpose of the study is to investigate factors that enable individuals to create successful resilience in the digital space. The research is looking at what factors influence the perceived readiness of digital resilience among individuals, in the context of Qatar. Digital resilience refers to implementing and using information technologies to recover and move forward when faced with challenges.
This research could help to better understand what is required for individuals to become more digitally resilient, able to adjust to dependence on technology and to create a new norm in the digital space. Preparation for and adjustment to this new norm has become even more important due to the impact of COVID-19 on our daily lives.

Procedures

You will receive a recruitment email sent on behalf of the Senior Honors student Principal Investigator, with this Project Information Sheet attached and a web link for the online survey. To take the survey, if you are interested and eligible to participate, click on the online web link to access the survey. The survey is estimated to take 10-15 minutes to complete. You are also invited to forward the recruitment email to any others in Qatar whom you think might be interested in taking the survey.

Participant Requirements

- 18 years or older
- Qatar citizen or resident currently residing in Qatar for 1 year or more
- Able to read, speak and write in English

Risks

The risks and discomfort associated with this study are no greater than those ordinarily encountered in daily life or during other online activities.

Benefits

There may be no personal benefit from your participation in the study, but the knowledge received may be of value to humanity.

Compensation & Costs

There is no compensation for participation in this study. There will be no cost to you if you participate in this study.

Confidentiality

By participating in the study, you understand and agree that Carnegie Mellon may be required to disclose your consent form, data and other personally identifiable information as required by law, regulation, subpoena or court order. Otherwise, your confidentiality will be maintained in the following manner:

Your research data will be stored in a secure location on Carnegie Mellon property. Any information provided in this survey are confidential. Data gained will be used solely for the purpose of research. Data will only be seen by the researchers. By participating, you understand and agree that the data and information gathered during this study may be used by Carnegie Mellon and published and/or disclosed by Carnegie Mellon to others outside of Carnegie Mellon. However, your name, address, contact information and other direct personal identifiers will not be mentioned in any such publication or dissemination of the research data and/or results by Carnegie Mellon. Note that per regulation all research data must be kept for a minimum of 3 years.

Right to Ask Questions & Contact Information

If you have any questions about this study, you should feel free to ask them. If you have questions later, desire additional information, or wish to withdraw your participation, you can contact the Senior Honors Thesis Principal Investigator and/or Faculty Advisors using the contact information listed on the first page of the Project Information Sheet sent to you in the email telling you about this survey.

If you have questions pertaining to your rights as a research participant, or to report concerns to this study, you should contact the CMU-Q IRB by email (cmuq-irb@qatar.cmu.edu) or by phone (4454-8669).

Voluntary Participation

Your participation in this research is voluntary. You are free to stop your participation at any point. Refusal to participate or withdrawal of your consent or discontinued participation in the study will not result in any penalty or loss of benefits or rights to which you might otherwise be entitled. The Principal Investigator may at their discretion remove you from the study for any of a number of reasons. In such an event, you will not suffer any penalty or loss of benefits or rights which you might otherwise be entitled.

I am age 18 or older. ☐ Yes   ☐ No
I am a Qatar citizen or resident currently residing in Qatar for 1 year or more. ☐ Yes   ☐ No
I am able to read, speak and write English. ☐ Yes   ☐ No
I have read and understand the information above. ☐ Yes   ☐ No
I want to participate in this research and continue with the survey. ☐ Yes   ☐ No

Section 1. Profile

Please answer the following questions by ticking (√) a suitable box or by filling in the blanks.

1. I am a:

❏ Male
❏ Female
❏ Prefer not to say

2. I consider myself as:

❏ Qatari
❏ Expat

3. My age is:

❏ 18-19
❏ 20-29
❏ 30-39
❏ 40-49
❏ 50 years or above
❏ Prefer not to say

4. I have lived in Qatar for _____ years:

❏ 1-5 years
❏ 6-10 years
❏ 11-20 years
❏ 21-30 years
❏ More than 30 years

5. My highest education is:

❏ Elementary/Middle School
❏ High School
❏ Bachelor Degree

❏ Master Degree
❏ PhD

6. My occupation is:
❏ Student
❏ Employee/self employed
❏ Unemployed
❏ Retired

7. My annual income:

❏ Less than 100,000 QR
❏ 100,000 QR - 200,000 QR
❏ 200,000 QR - 300,000 QR
❏ 300,000 QR - 400,000 QR
❏ More than 400,000 QR
❏ Prefer not to say

8. Before Covid-19, I preferred banking_____ :

❏ In-person
❏ Online

9. During Covid-19 lockdown, I_____ :

❏ Waited for banks to reopen
❏ Shifted to online banking

10. Now, I bank_____ :

❏ In-person
❏ Online

11. Before Covid-19, I preferred shopping_____ :

❏ In-person
❏ Online

12. During Covid-19 lockdown, I_____:

❏ Waited for shops to reopen
❏ Shifted to online shopping

13. Now, I shop_____:

❏ In-person
❏ Online

14. I currently work/study_____:

❏ In-person
❏ Online

15. I find the shift to digital environment_____:

❏ Easy
❏ Neutral
❏ Challenging

Section 2. Survey

Please indicate your answer on the following scale with a tick (√) on the most suitable box.

Community Capital							
	Strongly Disagree 1	Disagree 2	Somewhat Disagree 3	Neutral 4	Somewhat Agree 5	Agree 6	Strongly Agree 7
People in my community help each other.							
I have a strong tie in my community.							
I have friends in my communities.							

Family Support							
	Strongly Disagree 1	Disagree 2	Somewhat Disagree 3	Neutral 4	Somewhat Agree 5	Agree 6	Strongly Agree 7
When I face a disruptive event, I have family members who help me							
When I face a disruptive event, I have family members who encourage me							
When I face a disruptive event, I have family members who are optimistic in difficult situations							

Psychological Resilience							
	Strongly Disagree 1	Disagree 2	Somewhat Disagree 3	Neutral 4	Somewhat Agree 5	Agree 6	Strongly Agree 7
I am able to adapt to change							
I tend to bounce back after hardship and can cope with stress							

I can achieve goals despite obstacles.							
I can stay focused under pressure.							
I can deal with whatever comes.							

Access to Technology							
	Strongly Disagree 1	Disagree 2	Somewhat Disagree 3	Neutral 4	Somewhat Agree 5	Agree 6	Strongly Agree 7
I have access to computer whenever I need it							
I have a strong internet connection/infrastructure							
I can purchase technology when needed							

Digital Literacy							
	Strongly Disagree 1	Disagree 2	Somewhat Disagree 3	Neutral 4	Somewhat Agree 5	Agree 6	Strongly Agree 7
I am skilled in using computers for basic tasks.							
I possess the expertise to use basic technologies for basic online activities.							
I know how to use different information systems to perform basic day to day activities.							

Self-efficacy

	Strongly Disagree 1	Disagree 2	Somewhat Disagree 3	Neutral 4	Somewhat Agree 5	Agree 6	Strongly Agree 7
I could complete a task using technologies if there was no one around to tell me what to do as I go.							
I could complete a task using technologies if I could call someone for help if I got stuck.							
I could complete a task using technologies if I had just the built-in help facility for assistance.							

Perceived Digital Resilience

	Strongly Disagree 1	Disagree 2	Somewhat Disagree 3	Neutral 4	Somewhat Agree 5	Agree 6	Strongly Agree 7
Overall, during COVID 19, I am equipped with necessary resources to operate in digital environment.							
Overall, during COVID 19, I am mentally able to adapt to digital environment.							
Overall, during COVID 19, I find it is easy to bounce back from disruptive events by operating on digital platforms.							
Overall, during COVID 19, I am technically able to adapt to digital environment.							

APPENDIX C: PARTICIPANT INFORMATION SHEET

Study Title: Exploring Digital Resilience in Qatar: A Socio-technical perspective

Principal Investigator: Yara Al-Abdulghani, CMU-Q, ynabdulg@andrew.cmu.edu

Faculty Advisors: Dr. Savanid Vatanaksadakul, CMU-Q, svatanas@qatar.cmu.edu
Dr. Chadi Aoun, CMU-Q, chadi@cmu.edu

Sponsor: Carnegie Mellon University in Qatar

Purpose of this Study

This survey is part of an undergraduate Senior Honors Thesis research project being conducted by Principal Investigator, Yara Al-Abdulghani under the supervision of her Faculty Advisors Dr. Savanid Vatanaksadakul and Dr. Chadi Aoun at Carnegie Mellon University in Qatar (CMU-Q) in Education City. The purpose of the study is to investigate factors that enable individuals to create successful resilience in the digital space. The research is looking at what factors influence the perceived readiness of digital resilience among individuals, in the context of Qatar. Digital resilience refers to implementing and using information technologies to recover and move forward when faced with challenges.
This research could help to better understand what is required for individuals to become more digitally resilient, able to adjust to dependence on technology and to create a new norm in the digital space. Preparation for and adjustment to this new norm has become even more important due to the impact of COVID-19 on our daily lives.

Procedures

Participants will receive a recruitment email sent on behalf of the Senior Honors student Principal Investigator, with this Project Information Sheet attached and a web link for the online survey. To take the survey, interested eligible participants click on the online web link to access the survey. The survey is estimated to take 10-15 minutes to complete. Participants are also invited to forward the recruitment email to any others in Qatar whom they think might be interested in taking the survey.

Participant Requirements

- 18 years or older
- Qatar citizen or resident currently residing in Qatar for 1 year or more
- Able to read, speak and write in English

Risks

The risks and discomfort associated with participation in this study are no greater than those ordinarily encountered in daily life or during completing online surveys.

Benefits

There may be no personal benefit from candidate's participation in the study but the knowledge received may be of value to humanity.

Compensation & Costs

There is no compensation for participation in this study. There will be no cost to participants if they participate in this study.

Confidentiality

By participating in the study, participants understand and agree that Carnegie Mellon may be required to disclose their consent form, data and other personally identifiable information as required by law, regulation, subpoena or court order. Otherwise, their confidentiality will be maintained in the following manner:

The participant's data and consent form will be kept separate. The participant's research data will be stored in a secure location on Carnegie Mellon property. Sharing of data with other researchers will only be done in such a manner that the participant will not be identified. By participating, the participant understands and agrees that the data and information gathered during this study may be used by Carnegie Mellon and published and/or disclosed by Carnegie Mellon to others outside of Carnegie Mellon. However, the participant's name, address, contact information and other direct personal identifiers will not be mentioned in any such publication or dissemination of the research data and/or results by Carnegie Mellon. Note that per regulation all research data must be kept for a minimum of 3 years.

Rights

Their participation is voluntary. They are free to stop their participation at any point. Refusal to participate or withdrawal of their consent or discontinued participation in the study will not result in any penalty or loss of benefits or rights to which-they might otherwise be entitled. The Principal Investigator may at his/her discretion remove-them from the study for any of a number of reasons. In such an event, they will not suffer any penalty or loss of benefits or rights which-they might otherwise be entitled.

**Right to Ask Questions & Contact Information**

If they have any questions about this study, they should feel free to ask them. If they have questions later, desire additional information, or wish to withdraw their participation, they can contact the Senior Honors Thesis Principal Investigator and/or Faculty Advisors using the contact information listed on the first page of this Project Information Sheet.
If they have questions pertaining to their rights as a research participant, or to report concerns to this study, the participant should contact the CMU-Q IRB by email (cmuq-irb@qatar.cmu.edu) or by phone (4454-8669).

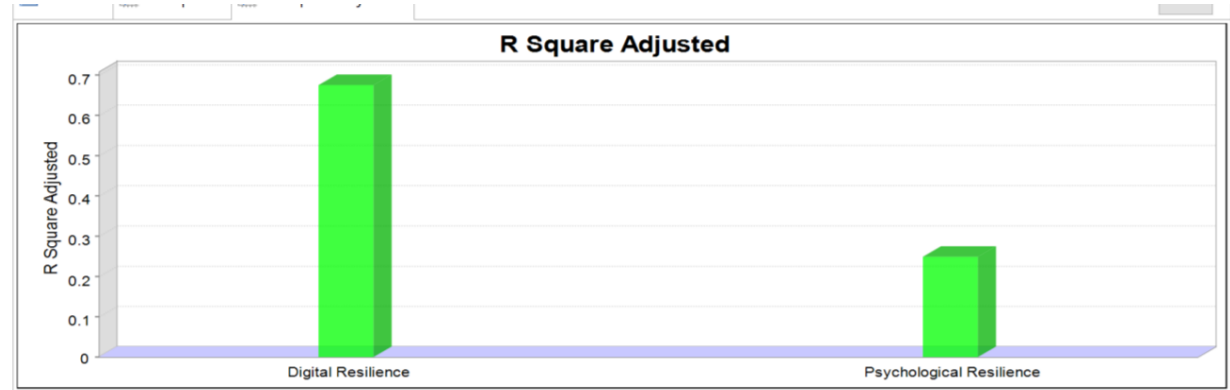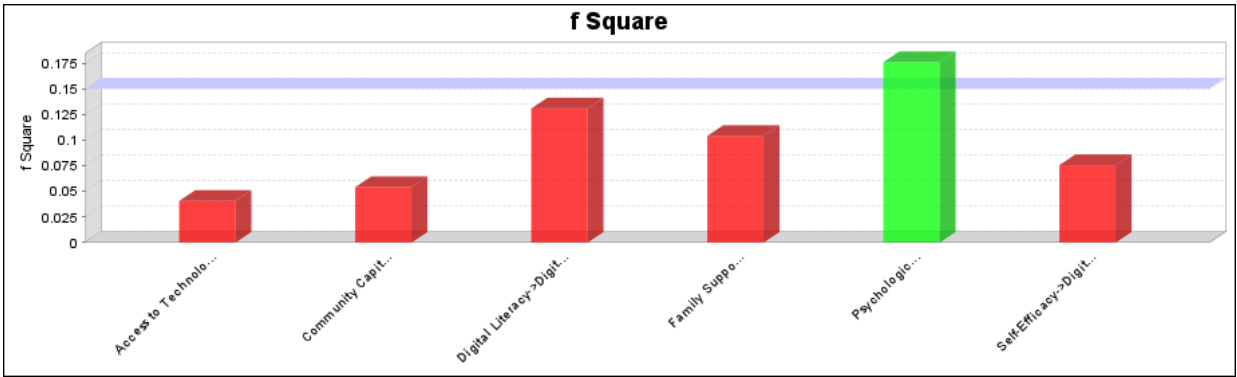# APPENDIX D: SMARTPLS GENERATED CHARTS

PATH COEFFICIENT

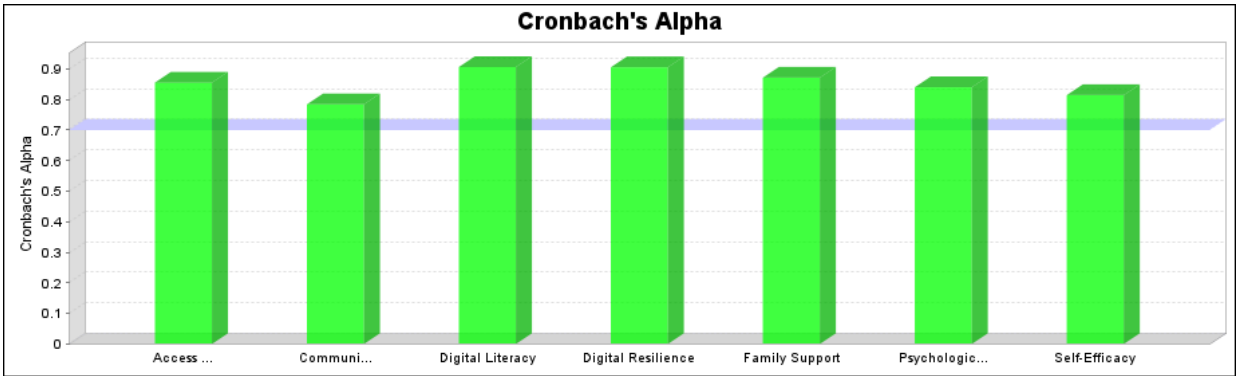
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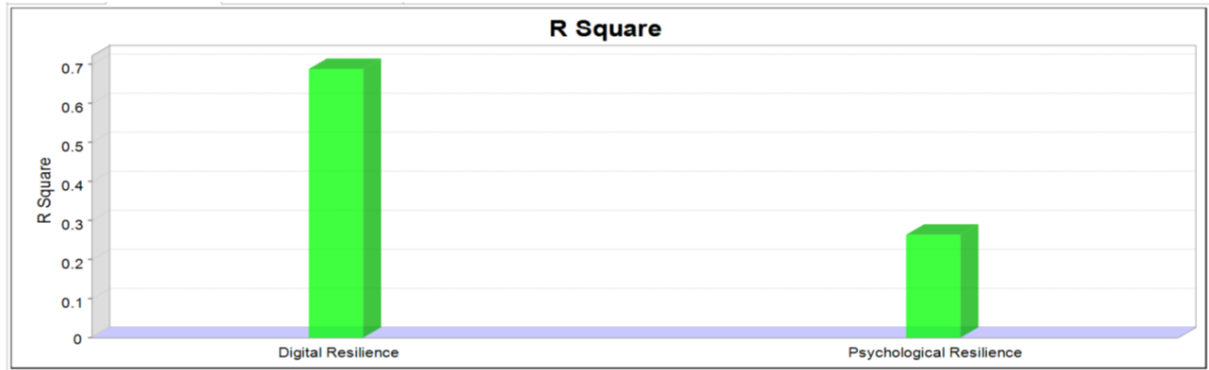
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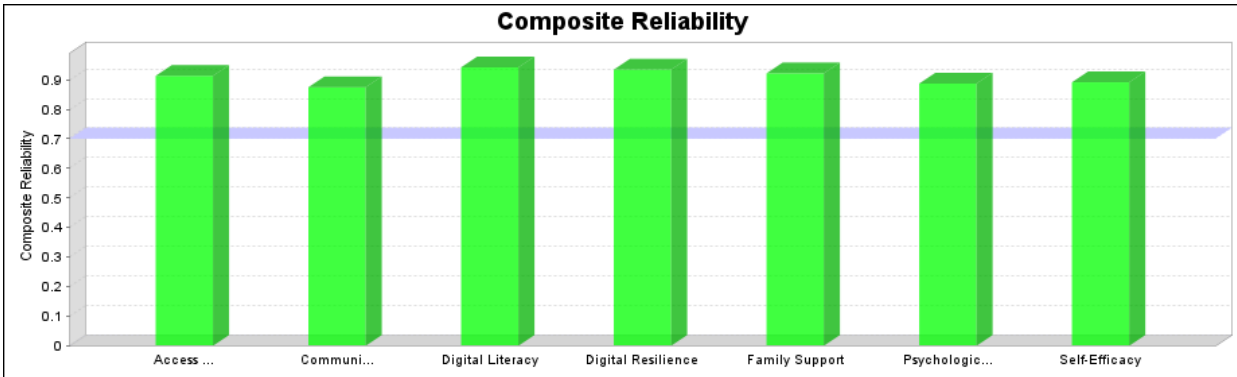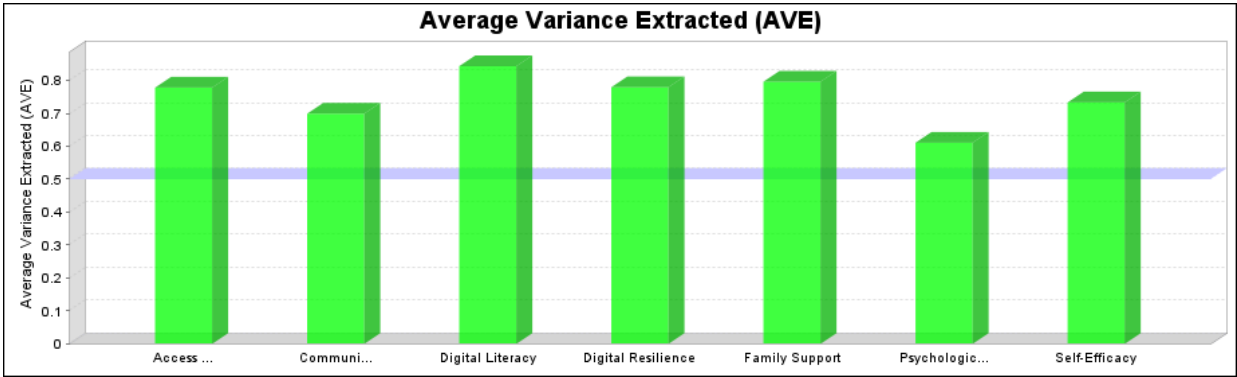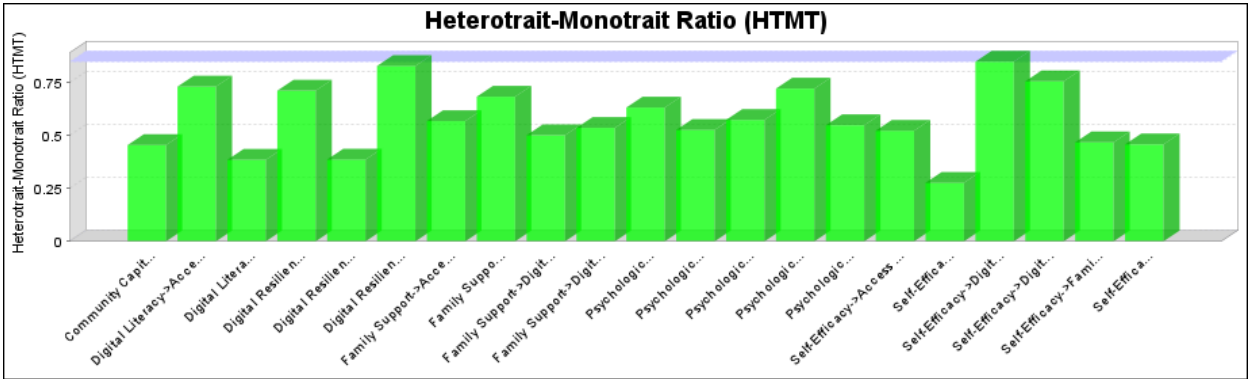
F-SQUARE

CRONBACH'S ALPHA

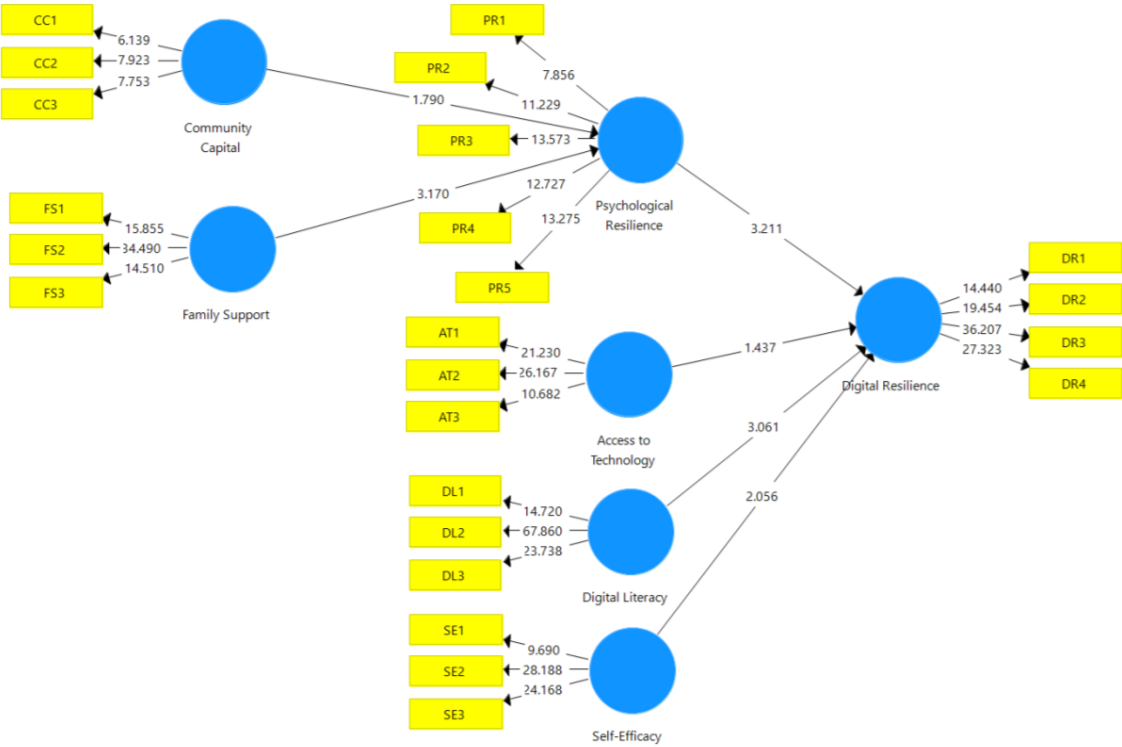## COMPOSITE RELIABILITY

AVERAGE VARIANCE EXTRACTED (AVE)

HETEROTRAIT-MONOTRAIT RATIO (HTMT)

APPENDIX E: STRUCTURAL MODEL (T-STATISTICS)

APPENDIX F: STRUCTURAL MODEL (CROSS-LOADING & PATH COEFFICIENT)