DIGITAL TRANSFORMATION IN A POST-COVID WORLD

Sustainable Innovation, Disruption, and Change

Edited by
Adrian T. H. Kuah
Roberto Dillon

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Introduction

Standing on the Shoulders of Giants: Sustainable Innovation, Disruption and Change

'Standing on the shoulders of giants' is a metaphor used frequently in signifying that intellectual progress is made by means of extending the knowledge and understanding gained by major thinkers who are giants in their own rights.

'If I have seen further,' Isaac Newton wrote in a 1675 letter to fellow scientist Robert Hooke, "it is by standing on the shoulders of giants."[1] It is easier to learn from geniuses like Newton and Hooke, but even their work and ideas had been built upon the work and ideas of others before them.

Ideas for innovation and change have to come from someone or somewhere. No matter how unprecedented a work seems, dig a little deeper and you will find that the creator stood on someone else's shoulders. With each preceding observation, idea or reflection, one could see a little further. In turn, our thoughts and ideas would form the basis of the knowledge and progress for future generations. We would argue that 'Standing on the shoulders of giants' is a necessary part of innovation, disruption, and change.

The year 2020 started with all the usual promises of further technological advancements and a global economic rally that showed no signs of slowing down. Little did we know that, in a matter of weeks, our usual lifestyle and established habits were to be completely disrupted and we had to rethink the way we live and work together. The sudden rise of the COVID-19 pandemic forced all of us, across all industrial and academic

fields, to go back to the writing board. We not only had to reimagine how to keep innovating, but also how to do old things in a new way.

This book captures how giants of our time – industry giants and thought leaders in their respective fields – across several geographical regions and domains faced this time of crisis, how they analysed the new, fast-evolving scenarios around them and finally found the right inspiration to move forward by recommending best practices for all of us to follow. The book brings together a mosaic of great ideas, observations and reflections from these giants on the importance of digital transformation in a post-COVID world by reliving some of their experiences.

Our lives were disrupted in many ways as the pandemic had a truly dramatic domino effect with far reaching impacts. As business models were disrupted and businesses closed around the world, we will see how leaders had to step-up and use technology as a mean to rethink their operations from the ground-up. Indeed, digital technologies permeate all aspects of modern life: mobility, health, education, work, communication, and so on. The ability to integrate these into our daily routines has literally become a matter of survival and we can do this only by remaining flexible. The ability to pivot towards new solutions as new trends emerge and force us to shape new strategies is indeed a common theme across the book.

At the same time, we also want to stress the importance of remaining vigilant and up to date with the latest technological trends as such drastic transformations do have hidden dangers, such as cyber security threats and privacy concerns.

The post-pandemic world will not be completely controlled by technology, though, as we still need to appreciate and, sometimes, rethink our lives in a fully holistic way. We should never forget about the spaces we live in and be sure that our living environment is still conducive to a healthy lifestyle, something we can easily fail to think of if we start living in a complete symbiosis with our computer screens.

A new idea on sustainable innovation, disruption and change is only possible because a giant opens a new door by introducing their idea, observation or reflection. They in turn opened new doors and expanded the realm of possibility. Science, art and other technological advances are only possible if someone else has laid the groundwork; nothing comes from nothing. Scientists like Newton and Hooke advanced science because of preliminary discoveries that others had made. With diverse contributions stemming from public health, technology strategies, urban planning and sociology to sustainable management, this volume is articulated into

four distinct but complementary sections of People, Process, Planet and Prosperity influencing the post-COVID world.

PEOPLE

The **People** section discusses the basis of human wellbeing, mental health and the roles of leaders in business and society during and after the COVID-19 pandemic, as well as changes to industries, such as digital currencies, telework, retail and online shopping. Our thought leaders, such as Michael S. Tomczyk and Victor Mills, reflect on their observations on trends, leadership and challenges arising from the crisis, particularly in the United States and Singapore. In this context, telehealth proves to be one winner for mental health services in a post-pandemic world. Caryn West, Professor of Nursing, and Christopher Rouen at James Cook University examine the importance of telehealth mobilised by the COVID-19 pandemic, together with the impact and implications of large-scale infectious disease outbreaks, arguing why COVID-19 has the potential to negatively impact mental health and wellbeing. Research suggests that COVID-19 has resulted in an increase in the prevalence of psychological distress within general populations and an intensification of psychological distress among individuals. Additionally, the numerous uncertainties caused by COVID-19 are predicted to increase suicide rates and mental disorders associated with suicide in the foreseeable future. The importance of telehealth then cannot be understated. Although it will be important to invest in mental health now to assist individuals in these challenging times, it is likely that the effects of COVID-19 will linger slightly longer, highlighting the need to minimise the echo effects of COVID-19 into the future.

Victor Mills, Chief Executive of the Singapore International Chamber of Commerce, reflects on ethical behaviour in the business world and selfless leadership exhibited by some leaders. The COVID-19 pandemic has increased peoples' appreciation of authenticity, the ability to communicate with empathy and to act decisively in the best interests of the whole community. One positive aspect arising from the pandemic, Mills contends, is that business leaders are more aware of their own mental health and that of their team.

Companies and countries failed during this pandemic because of a failure of leadership in business and in public life. Mills examines the unintended consequences of globalisation and international trade in Singapore, and the importance of collaborative leadership. He contends that "selfless, constructive, collaborative leadership" is imperative. In this

crisis, businesses need to work together to win the trust of their teams, customers, investors, and communities to transit into a newer economy from "wasteful linear to circular models of production and consumption".

Humans should not shirk on their responsibilities and accountability as leaders – acting for the common good. Too many of us abdicate leadership to others without recognising our responsibilities as citizens to participate in the life of the communities. Many reject the notion that they have any power to influence elections, reflects Mills. He further argues that during this pandemic, a large part of individual leadership is caring about positive outcomes for the community and for the country, as well as for the individual.

Michael S. Tomczyk, the technology pioneer responsible for bringing computers in the home of millions while at Commodore in the early 1980s and later a managing director of the Mack Institute for Innovation Management at The Wharton School, reflects on his observations in the United States, as businesses have to invent new ways of communicating, new ways of selling things, new ways to shop and new ways of running their operations.

One of the major behavioural changes accelerated by this pandemic was the shift from 'on schedule' to 'on demand' services, observes Tomczyk. Instead of accessing a product or service at a time or place determined by the seller, a buyer chooses when and whence to shop, with the item delivered directly to them, often with free shipping. This shifted temporal and spatial boundaries, which also affected the movie and entertainment industries. He further argues for the need of a cashless society and financial technologies. Advanced technologies are redefining the concept of money from paper bills and metal coins to digital currencies, he notes.

As a futurist, Tomczyk sees the continued rise of telework, 3D shopping, and online shopping. He notes that the pandemic has created a wide variety of chain reactions or 'dominoes' that have threatened and transformed our society. Supporting Mill's observation, Tomczyk points out the Yin–Yang tug of war between too much and not enough government control. His strongest takeaway from COVID-19 is that this crisis has given the world a wakeup call to better adapt to future crises.

The continued rise of digital servitisation and online shopping also threatens the retail industry worldwide – post-COVID, Debenhams in the United Kingdom and Robinsons in Singapore are examples of iconic stores that have joined a long list of well-known retailers called into administration. What lessons can future leaders learn from this turn of events?

Malobi Mukherjee, a futurist and research fellow from the University of Oxford and now lecturing in James Cook University, provides her perspectives on the traditional retail sector. Mukherjee proposes three retail scenarios for a post-COVID world that provide future safe spaces for retailers to develop resiliency. Her viable scenarios pertain to a hyper-tech world, an insular world, and a greener world, which entails real estate owners assuming the role of collaborative creators – a mutually beneficial nexus of new relationships and cooperative ecosystem.

PROCESS

The *Process* section investigates how workplace processes have experienced changes enabled by technology. Digital transformation took place in different sectors in a variety of ways, as more activities moved online and the definition and constraints of space and time warped. Nonetheless, digital transformation has its own unique risks and challenges, as we witnessed increases in cybercrime that affected governments all around the world and companies regardless of their size.

Christopher Warren, Managing Director, Strategy & Consulting at Accenture, helps navigate these new uncharted waters by discussing a technology roadmap to illustrate how different companies can pivot their businesses in the post-pandemic economy effectively. Indeed, technology has a major part to play in dealing with the pandemic and will continue to do so post-COVID. Warren discusses the roles and skills of chief information officers (CIOs), chief technology officers (CTOs) and enterprise architects to deliver value post-pandemic. Ultimately, success will follow those who can pivot quickly as the environment changes and those who can define a journey forward.

The concept of a roadmap to strategise for the future, something especially needed in time of crises, is at the centre of the work by Professor Agostino G. Bruzzone and Dr. Marina Massei of the University of Genoa. Bruzzone and Massei point out that many issues in current corporate strategies are due to a myopic time horizon that emphasize short term gains or objectives based on targets set on the next quarter or the next political campaign. When disruption does happen, not only do such approaches fail, but future recovery will be hindered. Nowadays, advances in crucial sectors of simulation, modelling, artificial intelligence and data analytics have a huge potential, especially when connected with their capabilities to process the massive data generated by companies and institutions as well as by technological advances, such as sensor networks and the Internet of

Things. All these new tools enable us to look at the future via the inno-vative lenses of 'strategic engineering', a new discipline merging technol-ogy and business insights to provide a closed loop approach to aid in the decision-making process.

The inherent risks of technology should not be overlooked, though, and these are thoroughly discussed in two chapters dedicated to the critical field of cyber security. In 'Cyber Security: Evolving Threats in an Ever-Changing World', Associate Professor Roberto Dillon of James Cook University joins a team of leading experts from KPMG Singapore, Paul Lothian, Simran Grewal and Daryl Pereira, to assess the current situa-tion and the increased exposure of companies across all industries to a variety of renewed threats. Unfortunately, in the forced and sudden shift to remote working, security was often taken for granted with the conse-quence of opening up a digital risk gap where companies had to try to manage the scammers, fix their security infrastructures and launch new services securely, something they were often unprepared for. Attacks, such as stealing corporate credentials via phishing, have become widespread and a common occurrence. To provide a comprehensive picture of the new cyber security landscape we live in, the authors also explore how cyber security often gets intertwined with geo-politics and discuss high profile hacks like SolarWinds Orion, as well as widespread phishing techniques. All these examples are then brought together to exemplify how compa-nies can reassess risk and start thinking about managing digital and cyber risks in the post-COVID world in a more efficient way.

In 'Reducing Cyber Risk in Remote Working', Dillon joins Vihangi Vagal, cyber security consultant for Deloitte UK, in an in-depth analysis dedicated to the now critical home-office environment and the additional risks that such set-up brought to every company. Spear phishing, ransom-ware attacks, exposure of sensitive information via social engineering, denial of service attacks, exploiting bugs in the virtual private network (VPN) and other such threat actors are terms remote employees need to familiarise themselves with while organisations devise new approaches to mitigate cyber risk and protect the confidentiality, integrity and availabil-ity of their resources.

While many sectors had huge difficulties in adapting, it is also important to understand how others did manage to embrace the social consequences of the pandemic and use them at their advantage as additional tailwind to fly towards new industry paradigms at an even greater pace. Professor Marco Accordi Rickards from the University Tor Vergata of Rome, joined

by Micaela Romanini and Guglielmo De Gregori from the Vigamus Foundation, illustrates how and why online gaming has established itself as the most loved hobby during the different lockdowns. Rickards et al. argue that the changes set in motion by the new social restrictions have actually accelerated a shift towards cloud services that was already due to happen and that the flexibility of small to medium enterprises in this sector, unlike other entertainment industries, were very receptive to the changes.

PLANET

The different waves and reoccurrence of COVID-19 also meant unprecedented disruptions across a huge range of different global human activities. Some would even posit that such disruptions provided us with new opportunities not only for new cutting-edge technologies, like previously discussed in the first two sections of the book, but also for the planet as a way to rethink old procedures and practices that were proving ineffective or even harmful in the long term. The *Planet* section explores how we seized the moment to rethink alternative strategies towards the ways activities are organised and conducted, for example on education, city planning, and workplace transformation.

David J. Calkins in 'Digital Workplace Adaptation and the 20-Minute City' focuses the dramatic shift to the home office not from a technical perspective but from a more holistic one. The Gensler's Regional Managing Partner, in fact, discusses the dramatic challenges his global company had to face and considers whether it will be feasible to get back to the 'old ways' after the world is back to normal. It seems clear that, moving into the future, workers will expect to have the flexibility to continue to work from home. In the post-COVID world, the office will act as a facilitator for collaboration and social interaction. Companies may occupy less space as individual/focus work moves to homes or third places in the community. This trend may lead to significant changes in downtown areas, and landlords may begin to convert unused space to other uses to preserve their income streams. As a consequence, old commuting habits are going to be disrupted as people realise the time they have gained in lieu of commuting is a significant improvement to their lifestyle. This can have far reaching consequences, including the birth and development of new sub-urban areas, the so-called 20-Minute Cities, which may rise as important business centres in a not too far future.

Cities and landscapes are also at the centre of Adrienne Yuen's chapter, 'Nature, the Pandemic, and the Resilience of Cities: Case Study of Ottawa,

Canada'. Contrary to many countries where people were forced to stay at home in seemingly never-ending lockdowns, the COVID-19 pandemic has spurred many Canadians to spend more time outside, with an increase in outdoor activities such as running, hiking, biking, and use of public parks. In parallel, increased teleworking and time spent at home has driven a rise in demand for single-family homes, while the market for condominiums has softened. Taking the City of Ottawa as a case study, Yuen of the Standards Council of Canada explores these trends and outlines the consequent challenges and opportunities for sustainability. For example, we could have a potentially sustained trend of people moving out of the urban core and demanding larger homes with the accompanying need for land and infrastructure to service lower density communities. On the other hand, we also have an opportunity for creating more green spaces within cities, also called 're-greening', that could help maintain the attraction of urban living.

Modern, smart cities are also at the centre of rising privacy concerns, something that got into the spotlight recently as governments tried new ways to monitor citizens to track the pandemic. Melissa Wingard, a Senior Commercial Technology Lawyer at Phillips Ormonde Fizpatrick in Australia, reflects upon the disconnect commonly referred to as the 'privacy paradox', i.e. where people claim to care greatly about privacy, but then their actions rarely align with the concern expressed.

Among the many consequences of COVID-19, we saw the acceleration in the use of biometric data in technology to provide contactless solutions and implement contact tracing to address the unprecedented public health challenge. Biometric data is inherently identifiable as it uses our physical or behavioural human characteristics, such as our faces, eyes, gait, or finger prints, which are unique and unchangeable. Wingard highlights that as the information being collected moves from information about us to information that is fundamentally the essence of our being, the relative laws also need to be updated to empower individuals to manage and control their own biometric data so as to avoid being exploited.

The transformation of modern cities does not just affect areas such as landscaping or our privacy, though, but also includes other, far-reaching aspects of our lives, including education. Indeed, this sector was one that was hit the hardest as it had to reinvent itself overnight to accommodate new delivery methods. Professor Abhishek Bhati, together with Caroline Wong and Esther Fink of James Cook University, discusses these dramatic changes in affecting the education sector, too. By looking at a holistic approach to the on-boarding of students in the hybrid model of virtual

with face-to-face experience, Bhati et al. examine how disruption can lead to innovation in how and when learners engage with digital content and activities to ensure that the learning outcomes are still achieved despite the disruption. The experiences of this sector, arguably, had to go back to the writing board and reimagine not only how to keep innovating, but also how to do old things in a novel innovative way.

PROSPERITY

In the ***Prosperity*** section, thought leaders like Esposito, Lanteri, Tse, Kuah and Lockie join forces to conclude with a discussion on the future of food, sustainable development goals, and the circular economy, including alternative thinking that may lead to a more sustainable future with digital transformation aiding in the process.

COVID-19 has acted as an accelerator for digital transformation and sustainability. Managers find themselves needing to re-evaluate and take steps to change on digital transformation. Decision makers may still face sudden black swans and wildcards that lead to unexpected circumstances and rapidly shifting competitive scenarios. Professors Mark Esposito, Alessandro Lanteri and Terence Tse from Hult International Business School and ESCP Business School have observed, pivoted, and researched several points of junction, where current trends set the trajectory for future events. In their chapter, Esposito, Lanteri and Tse provide their thought leadership on their macro-level DRIVE and meso-level CLEVER frameworks in empowering firms to identify growth opportunities in this turbulent, post-pandemic world economy.

Esposito et al. narrow their research down to five macro-level mega-trends in the world, which they discuss in detail, post-pandemic: Demographic and social changes; resource scarcity; inequalities; volatility, scale and complexity; and, finally, enterprising dynamics. At the same time, they also share their framework of six strategic drivers: Collaborative intelligence; learning systems; exponential technologies; value facilitation; ethical championship; and responsive decision making that become ever-more important in the post-pandemic world.

The pandemic triggers considerations on how consumption and production patterns can be shifted to a more sustainable way. Sustainable consumption and production is about systemic change and 'doing more and better with less impact' to decouple economic growth from environmental degradation. Adrian T. H. Kuah, Associate Professor of Business, and Chang H. Kim of James Cook University argue how consumers have

changed their consumption patterns as they transited to increased online entertainment, shopping, and food delivery. The growth of online shopping and 3D shopping, also noted by Tomczyk earlier, led to a surge in the generation of unnecessary packaging wastes. The pandemic has exacerbated the gravitas of the situation, and the new norm of online retail is likely to remain.

The core of circular economy models – resource recycle and recovery, remanufacturing, product life extension, sharing platforms, and product as a service – seek sustainability through optimisation of resources and away from one-time consumption. Echoing Mills' assertion that customers, investors and communities must transit into a new circular economy, Kuah and Kim propose incorporating digital technologies to a reverse logistics system to create new values in the circular loop. Companies can deliver more than ever values through the active introduction of digitised service strategies, such as smart remanufacturing and smart recycling. Digital servitisation aids to close the circular loop by further introducing servitisation alternatives, such as leasing, renting, and sharing. Hence, the total use of resources can be reduced and sustainable consumption maintained.

Furthering sustainable production and consumption, Stewart Lockie, Distinguished Professor of Sociology at the Cairns Institute, discusses barriers along with opportunities to develop physical, regulatory and institutional infrastructures that support socially and environmentally responsible innovation in agriculture and the future of food. Advanced sensing, automation, the Internet of Things, data analytics, artificial intelligence, synthetic biology, distributed ledger and other emerging technologies offer a seemingly endless array of possibilities to boost agricultural productivity. None of these outcomes, Lockie argues, are inevitable due to identifiable barriers to technological innovation and adoption, which must first be overcome to achieve sustainable production of food for prosperity.

As the old adage goes, 'where there are problems, there are opportunities' and this has never been more true than today: at a time of an unprecedented crisis in our lifetime, we all have the duty to increase our efforts, stepping up on the shoulders of the giants who preceded us and establish new paths to safely fare into uncharted territory that will not only make us survive, but also thrive. The aim of this volume then is to act as a 'brainstorming' tool across many different fields, where every contributor freely shared his or her expertise, experience and thoughts not only to outline the dramatic

changes we are living in, but also, and most importantly, to inspire you, our reader, to seek new opportunities in the post-COVID world.

Adrian T. H. Kuah and Roberto Dillon
Singapore, 26 February 2021

NOTE

1. Newton, Isaac. "Letter from Sir Isaac Newton to Robert Hooke". Historical Society of Pennsylvania. Retrieved 7 June 2018.

I

People

The first section discusses the basis of human well-being, mental health, business and society that were heavily impacted by COVID-19, as well as how international political economy changes with trade tensions and restriction to travel affecting the future of business.

COVID-19

Implications for Mental Health and Well-Being, Now and in the Digital Future

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CONTENTS

1.1 INTRODUCTION

The expeditious spread of the severe acute respiratory syndrome coronavirus 2 (COVID-19) has forced individuals and communities to rapidly adapt in the face of challenging and unprecedented circumstances. Named for the 'corona' or crown-like thorns on their surface, coronaviruses possess a distinct morphology and cause a broad range of diseases in both humans and animals (Tyrell, 1968). Seven coronaviruses are known to cause disease in humans, and of those, three are known to have resulted in severe to fatal respiratory infections (Tesini, 2020). The first of these, *SARS-CoV* was detected in China's Guangdong province towards the end of 2002 and presented as an influenza-like illness that, in a number of cases, progressed to severe respiratory insufficiency [severe acute respiratory syndrome (SARS)]. Between 2002 and 2004, *SARS-CoV* spread to over 30 countries with more than 8,000 cases reported worldwide (Institute of Medicine, 2004). The case fatality rate of *SARS-CoV* was approximately 10%, with individuals aged ≥ 65 years impacted most. Importantly, the *SARS-CoV* infectious outbreak was the first time that the Centers for Disease Control and Prevention (CDC) advised against travel to the regions affected (Institute of Medicine, 2004).

In September 2012, Middle East Respiratory Syndrome (MERS) caused by the MERS coronavirus (*MERS-CoV*) was reported in Saudi Arabia [World Health Organisation (WHO), 2018]. Causing mild to severe acute respiratory illness, approximately 2,500 cases of *MERS-CoV* have been reported from 27 countries to date. All transmissions have been linked through travel to, or residence in countries in and near the Arabian Peninsula; however, the largest outbreak occurred in the Republic of Korea during 2015 (Oh et al., 2018). Reflective of *SARS-CoV*, the median age of individuals affected by *MERS-CoV* was 54 years, with severe infection trends in patients with pre-existing conditions or comorbidities (WHO, 2018).

COVID-19 is an acute to severe respiratory illness caused by the novel coronavirus *SARS-CoV-2* (Esakandari et al., 2020). Believed to have originated in the Chinese city of Wuhan, *SARS-CoV-2* has spread to nearly every country on the planet and is considered by the CDC and the WHO to be a serious global health threat. Declared a pandemic on the 11 March 2020 (WHO, 2020), there were 106,865,939 confirmed COVID-19 cases and 2,338,004 deaths globally as of 10 February 2021 (Dong et al., 2020).

Like both *SARS-CoV* and *MERS-CoV*, the *SARS-CoV-2* virus has greatly impacted aged populations and individuals with existing conditions or

comorbidities. What differs is the speed in which *SARS-CoV-2* is able to progress to acute respiratory distress syndrome, death and/or for seemingly mild and recovered cases, result in serious post-infectious complications (Cascella et al., 2020). Although it is known that coronaviruses can, will and do mutate, *SARS-CoV-2* has exhibited the ability to mutate quickly and the variant strains appear to be super virulent and exponentially difficult to contain (Abdullahi et al., 2020). At the time of writing, three particularly concerning variant strains of *SARS-COV-2* have been identified which have further complicated global pandemic response efforts (Public Health England, 2020, Wu et al., 2021, Faria et al., 2021).

Current research suggests that COVID-19 has resulted in an increase in the prevalence of psychological distress within general populations and an intensification of psychological distress among individuals with pre-existing mental health disorders. Additionally, the numerous uncertainties caused by COVID-19 may influence suicide rates and mental disorders associated with suicide in the foreseeable future. Despite these potential negative consequences on mental health, COVID-19 has been a catalyst for digital transformation in many sectors, including education, finance, business and healthcare. Globally, health systems have struggled to provide optimum service delivery and meet demand. Tertiary healthcare centres have seen systems and staff pushed beyond limits in a desperate attempt to respond to societal needs and as a result, have been forced to employ unique and innovative means of conducting day to day business. The dramatic upscaling of telehealth has facilitated the continued provision of healthcare services whilst minimising the risk of COVID-19 transmission potential.

In this chapter, we provide an outline of the impacts and implications of large-scale infectious disease outbreaks, why COVID-19 is considered the 'perfect storm' and why it has the potential to negatively impact mental health and well-being now and in the post-pandemic phase. We will examine the current evidence of the impacts on mental health and well-being and how the digital transformation of healthcare – lead by telehealth – can assist in defending and redefining mental health and mental healthcare.

1.2 THE UNPRECEDENTED PERFECT STORM

Throughout history, infectious disease outbreaks have resulted in large-scale demographic, economic and political disruption. However, none in recent history have had the crippling effects of COVID-19. Unlike other large scale infectious disease outbreaks, COVID-19 and the associated

negative implications of well-intended and necessary prevention strategies have created a combination of widespread adverse factors, which have been described as an unprecedented 'perfect storm'. In recent history, there has been no equivalent infectious disease outbreak that has generated such widespread fear, drastic public health responses and considerable economic shock, that when combined, has the potential to significantly affect mental health and well-being on an unprecedented scale. The following explores in greater detail three major contributing elements that have been intrinsic in the creation of the COVID-19 'perfect storm'. Importantly, these elements cannot and should not be viewed only in relation to individuals who have known mental health diagnoses or are considered vulnerable. The uniqueness presented by COVID-19, particularly the perpetual cycle of the 'perfect storm' factors, has meant that vulnerability now exists where previously it did not.

1.2.1 Fear

Fear in itself is a natural inbuilt reaction that triggers biochemical, emotional and physical responses to perceived or real danger or threats. In most cases once the imminent threat has passed, the fear response subsides. However, fear is a multifaceted construct due to its subjectivity. Not all manifestations are homogenous nor all triggers universal. Some fears may be a result of experiences or trauma, while others may broadly represent a fear of the known or the unknown.

COVID-19 is unfamiliar, contagious, has invoked strong public health responses, changed everyday life, disrupted the social fabric and is associated with mortality. The very nature of a pandemic such as this justifiably creates fear. On a simplistic front, this fear allows individuals to confront and deal with potential threats, for example behaviours that assist with minimising the transmission of the virus, such as improving hand hygiene and encouraging adherence to physical distancing measures. However, depending on circumstances, personal and societal, the fear experienced may escalate resulting in a heightened and extended fear experience. It is this continued state of flux coupled with little or no respite that can result in negative mental health outcomes.

The difficulty COVID-19 poses for many is finding a 'fear' balance in a continuously changing landscape. Not enough fear creates the potential for conscious recklessness resulting in individual exposure to the virus and societal vulnerability due to breaches in public health measures. Excessive exhibitions of fear can result in anxiety, panic disorders, post-traumatic

stress disorder (PTSD), social anxiety disorder and many other mental health conditions. At a societal level, excessive fear may result in fear induced irrational behaviours such as panic buying and xenophobia.

For health professionals, COVID-19 presents an interesting global mental health challenge as it has influenced every aspect of life and has created disruption to the social fabric. Fears that once were experienced by few, such as the uncertainty of a diagnosis and the wait for results, are now experienced on a grand scale, resulting in scepticism, distrust and intolerance where previously none existed.

1.2.2 Quarantine and Isolation

Quarantine, isolation and related public health responses have collectively resulted in diminished access to our typical social networks. Social support and social connectedness serve as important 'gatekeepers' to mental well-being (Lee et al., 2018) and for most, bolster necessary protective factors (Yoshioka-Maxwell, 2020). For known vulnerable or at-risk populations, the ability to engage socially and seek support is a well-documented mitigation strategy to deter risky behaviour (Tucker et al., 2015, Golden et al., 2009, Yoshioka-Maxwell and Rice, 2017). From an impact perspective, clear evidence exists regarding the negative impacts of social isolation on mental health, substance use/abuse, homelessness, interpersonal violence and risk behaviour (Tsai and Wilson, 2020, Usher et al., 2020, Perri et al., 2020). So it would stand to reason that in the event of a pandemic, social cohesion, support networks and interpersonal contact would be a critical means of maintaining both individual and community well-being and mitigating potential risk. When measures such as mandated quarantine and extended isolation interrupt those social connections, individuals are more likely to be exposed to factors that are associated with negative mental health outcomes that influence their health, safety and well-being.

1.2.3 Economic Shock

Across the globe, lives have been dramatically altered due to COVID-19. Global economic strain has stymied tourism, aviation, agriculture and finance, with all reporting drastic declines and massive reductions in both supply and demand (e.g. Ibn-Mohammed et al., 2021). Local and national economies have been crippled through sanctioned infection, prevention and control measures implemented with good intent, to reduce transmission rates (Nicola et al., 2020). In many countries, stimulus packages

have been introduced in an effort to keep the economy afloat and stave off recession and potential financial collapse (Siddik, 2020). For the average person, this level of economic adversity increases stress levels and anxiety creating vulnerability, loss of identity, depression and loss of purpose (Frasquilho et al., 2016). Additional stress factors linked specifically to the *SARS-COV-2* pandemic are underemployment, job instability and school and childcare closures, none of which are counted in unemployment numbers (Douglas et al., 2020). For many single- and low-income families, increased financial demands associated with childcare, the loss of free school meals and having to heat the home during the day will push them over the solvency threshold and into the welfare system (Douglas et al., 2020). It is estimated that in the United Kingdom alone, 3.5 million additional individuals will need universal credit because of COVID-19 (Benstead, 2020).

A catalyst to the impacts of the global economic crisis created by COVOD-19 is the number of individuals employed in the 'gig economy'. This free market system, aimed to mobilise the workplace, is awash with temporary and independent workers employed for short-term commitments with no sick pay, vacation entitlements and often zero contract hours (Kuhn, 2016). As the pandemic continues, many within this group are at increased risk of rent or mortgage arrears and potential homelessness.

As with fear and isolation, there is a clearly established link between employment/income and health (Morris et al., 2000). Lower income earners are known to experience higher levels of psychological stress. When economies falter, it is often these workers that bear the brunt of the downturn with women and young workers often faring the worst (Douglas et al., 2020).

Within the health sector, the associated health consequences caused by economic demise are complicated. Gross unemployment negatively affects both physical and mental health exacerbating known diagnoses and increasing the risk of both homicides and suicide (Paul and Moser, 2009). A large-scale meta-analysis indicated a '76% increase in all-cause mortality in people followed for up to 10 years after becoming unemployed' (Roelfs et al., 2011). Looking forward into the post-pandemic landscape, these findings indicate there is a high likelihood of increased disadvantage and vulnerable and displaced individuals which could prohibit a hard reset of the employment sector leading to drawn out financial hardship.

As much of the world's population retreats indoors due to dropping temperatures, areas of congregate living, overcrowding, poor ventilation and high density populous calamitously combine to create the risk of yet

another wave, resulting in further lockdowns and potential increased loss of life. Until a viable and globally accessible vaccine is available and widely implemented, governments around the world will continue to respond to the pandemic with a strong focus on public health measures aimed at eliminating, containing and/or slowing the virus. Although such strategies may well achieve the desired reduction in COVID-19 transmissions, the conditions of the unprecedented 'perfect storm' and potential cyclic nature of additional outbreaks will likely continue to have a significant impact on mental health and overall well-being.

1.3 COVID-19 AND MENTAL HEALTH

At the time of writing, the available evidence concerning the negative impact of COVID-19 on mental health is limited to the initial phase of the pandemic; although historic evidence from previous infectious disease outbreaks suggests that the consequences of COVID-19 are likely to be long-term. Despite this limitation and acknowledging the number of potential variables that could influence positive mental health outcomes, the current evidence remains damning and leads us to believe that the global impact on mental health will be considerable and linger after the pandemic has subsided. Individually, each element of the 'perfect storm' has the potential to cause widespread damage and poor mental health outcomes. Not only are the elements cumulative but they are ongoing and pervasive with little respite and no endpoint. The impact of COVID-19 on mental health will be influenced by the unique circumstances and experiences of the individual; however, for discussion, we examine the impacts on persons infected with COVID-19, healthcare workers and the general population.

1.3.1 Persons Who Have Been Infected with COVID-19

What would make people get it? … most adults have had a seriously unpleasant … illness. Maybe a persistent bad fever with hallucinations; a chest infection, with a painful cough, maybe with scary breathing problems; or severe systemic pain; vomiting and diarrhoea; dermatological problems; unusual bleeding; extreme weakness or fatigue; or something involving massive weight loss and muscle wasting; taste and smell disorders; frightening paraesthesia; joint pain. We've all had one or two of those things. They're in our lexicon of experience. On their own they're not alien. What is alien is having them all at once over many weeks. That's part of what severe COVID is: it's 5 or 10 illnesses at once.