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Mitigating pandemics through the adaptation of digital technologies – towards a digital resilience framework

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Abstract - This paper reports a qualitative analysis of the literature search output of studies on digital technology interventions deployed specifically in the G7 countries in response to the recent pandemic. This is followed by interviews with eighteen participants from the G7 countries about their experiences in adapting digital technologies to mitigate the effect of the pandemic. Using a thematic analysis approach, the study uncovers two streams of digital technology resilience: digital resilience in public and private spheres; and healthcare and well-being in the digital age. Together with a set of identified technology-driven and individual-driven resistance and enabling factors, a model of a proposed digital resilience (DigiRES) framework is developed for validation and in-country contextualization. The implications of the study for preparedness for future pandemics or crises are highlighted.

Keywords - Digital resilience, framework, G7, interventions, pandemics, technology

I. INTRODUCTION

Digital technologies have become pervasive in our daily lives and almost every facet of life. From online shopping to commuting, and emergencies including the recent COVID-19 pandemic. There has been an argument as to whether society could have survived the pandemic with or without digital technologies, but there is still a lack of detailed documentation of people's experiences of how critical digital technologies were adapted to mitigate the effects of the pandemic. In addition, it is unclear how people across the world and in G7 countries, in particular, were able to build resilience by using digital technologies during the pandemic, and the challenges and lessons learnt in preparation for future pandemics.

The G7, or the International Group of Seven, represents a forum consisting of Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States. It is an informal grouping of seven wealthy nations which has existed since 1975.

G7 countries have a collective annual GDP of \$40 trillion or just under half of the global economy. Initially, it was formed to examine prospective solutions to global economic and financial problems, such as the oil crisis and pandemics like COVID-19 [1]. However, despite the

considerable investment made by the G7 nations in research and digital technology interventions during the COVID-19 pandemic, their economies, and especially that of the UK, were among the hardest hit [2]. The levels of success in adopting and adapting digital technologies such as the contact tracing apps, to cope with the pandemic were very low [3] raising questions about the resilience of the technologies and citizens during the COVID-19 pandemic and preparedness for future pandemics [4].

Resilience has been defined differently by different authors, often based on the context [5]; [6]. *For example*, Resilience is defined “as the ability to absorb, adapt and transform from shocks” [4], [7] or the ability “to persist, adapt, or transform in the face of change” [8]. According to Pinkwart, Schingen, Pannes, & Schlotboller [9], “resilience begins with preparing for a future crisis”. Although resilience consists of four dimensions, namely resistance (adaptability), recovery (capability), re-orientation (avoidance of negative consequences) and renewal (sustainable changes), it is not clear which aspects helped help citizens to mitigate the recent pandemic.

UKCIS Digital Resilience Working Group [10] defines digital resilience within the context of online environments, whilst Weller and Anderson [6] define digital resilience in the context of education. Digital Resilience, for this study, has two possible connotations of the term:

1. The resilience of an individual, group or firm in relation to the risks that digital technologies can present.
2. Resilience to risks created by (extraordinary) events to individuals, groups or firms by managing such risks through digital technologies.

The researchers, however, conceptualize digital technology resilience as “the flexibility of technologies and citizens’ capacity to embrace digital technological interventions in times of crisis to function efficiently without making significant changes to their existing lifestyles.”

This study adopts a qualitative approach through a review of the literature on the digital technology interventions deployed in the G7 countries in response to

the COVID-19 pandemic. This is followed by interviews with citizens in some of the G7 countries to understand their lived experiences and challenges and how they were able to adapt digital technology interventions to mitigate the pandemic and emerge resilient. The rest of the paper covers the methodology adopted for the study, the results and discussion, and the conclusion, potential impact and future research.

II. METHODOLOGY

The study uses a 2-step qualitative approach involving analysis of the literature on digital technology interventions during the pandemic and responses from interviews with citizens in G7 countries.

With a well-defined search problem, which is to review the literature on the digital technology interventions deployed in the G7 countries in response to the COVID-19 pandemic, a search was conducted on the Scopus database.

After several iterations of experimenting with search terms starting with TS=((digital intervention OR digital resilience) AND (covid or pandemic))” which yielded an initial 2236 articles, the search string used was TS=((digital intervention OR digital resilience) AND (covid or pandemic) AND ('G7' OR 'Canada' OR 'France' OR 'Germany' OR 'Italy' OR 'Japan' OR 'UK' OR 'U.K.' OR 'United Kingdom' OR 'US' OR 'U.S.' OR 'USA' OR 'United States')). This yielded 425 articles since it explicitly focused on G7 countries. The search was limited to papers published in English, with the type of documents being reviews or articles.

The data from both the literature search and interviews are analysed using the six stages thematic data analysis approach [11]. The results are presented and discussed in the next section.

III. RESULTS AND DISCUSSION

The scope of the 425 articles used for the qualitative analysis of the literature ranges from healthcare sciences, and medical informatics to management, business and social sciences.

The results (Table I) show that digital technology interventions in the G7 countries during the pandemic helped the citizens build resilience in public and private spheres. These relate more to using digital technologies using mobile phones, tablets, laptops, and apps such as MS Teams, Zoom, WhatsApp, and other teleconferencing systems for work (economic) and education purposes. Equally important was the use of digital technologies for personal life for communication and engagement with family, friends and loved ones.

Another aspect of digital technology interventions in the G7 countries during the pandemic was in helping citizens build resilience around healthcare and wellbeing. The adaptation of digital technologies for healthcare was

paramount for the citizens in reducing the psychological and social impacts of the pandemic. These relate more to the use of telemedicine, fitness apps, online support for mental health and healthcare services during the pandemic.

TABLE I
Overview of the thematic analysis of the literature

Concepts	Themes	Aggregate Dimensions
Telecommuting	Work and Education	Digital Resilience in Public and Private Spheres
Online Learning	Transformation	
Digital Divide		
Digital Technology Use	Technology and Digital Engagement	Healthcare and Well-being in the Digital Age
Emergency Responses		
Healthcare Delivery	Healthcare System Adaptation	
Healthcare Seeking Behaviour		
Family Therapy Techniques	Psychological and Social Impacts	
Mental Health Challenges		

In addition, preliminary interviews were conducted with eighteen citizens from the G7 countries. The participants were individuals residing permanently in the G7 countries. Most of the participants were young adults of working age working in various sectors of the economy. Specifically, out of the eighteen participants interviewed, ten were females and eight were males. The ages of the participants were between 22 to 50 years, with an average age of about 32 years. They were mostly students, entrepreneurs, healthcare assistants, lecturers, consultants, researchers, and commercial managers in various industries, particularly education, health, construction, hospitality and retail.

The interview findings mostly confirmed the results from the qualitative analysis of the literature. For example, work and personal life were areas of most concern leading to citizens adapting digital technologies to mitigate the effect of the pandemic. For example, in explaining the critical role of digital technologies in surviving the pandemic, a participant said :

“.....it was vital for all of us, for our mental health and just for maintaining a sense of normality” (#2, UK).

The interview results also revealed that whilst citizens found it easy to use personal digital technologies that was

not the case with the digital technology interventions that were introduced by the government. Thus, the adaptation of digital technologies during the pandemic was not without challenges. For example, some citizens indicated it took them about three to six weeks to bounce back to normality or adjust to life after the onset of the COVID-19 using digital technology. Other challenges with the adoption and adaptation of digital technologies during the pandemic included privacy concerns and social-media misinformation [12]. There were, however, some positive outcomes in using technology during the pandemic mainly in terms of upskilling or the acquisition of new digital skills [13].

The responses from the interviews so far show some key skills are required for citizens to build resilience for future pandemics. For example, a participant stated these as “Digital literacy, adaptability and Self-discipline” (#1, Germany).

The qualitative analysis of the literature revealed several challenges and enabling conditions that influenced citizens' adoption and/or adaptation of digital technologies to mitigate the effect of the pandemic. These enabling and resistance factors include technology-driven factors such as privacy concerns, risk barriers, usage barriers, trust in technology and value beliefs about digital technology interventions [13]. The analysis of the literature also revealed that individual-driven factors such as trust in government [3], social influence, self-efficacy [14], and fear of COVID-19 [15] influenced how individuals adapted digital technologies to mitigate the pandemic.

The proposed DigiRES framework (Fig. 2) posits that both technological and individual-driven factors influenced how citizens adapted digital technology

interventions during the pandemic to build resilience. This has implications for the application of technology adaptation [16] and resilience theories [17] in understanding how digital technologies can best be leveraged to build resilience for future pandemics. Resilience has implications for well-being, therefore the DigiRES framework posits that citizens' digital technology resilience would have a significant impact on their well-being including physical health, social, psychological, mental, emotional, economic and financial well-being [18].

The interview data revealed that the pandemic affected citizens' well-being in various ways. This included social well-being, as indicated by some participants – “Ohh, probably social aspects. My social life”. (#6, Germany); economic well-being as stated by another participant – “...working in the hospitality industry as I faced job loss due to lockdowns and restrictions (#2, Germany). The impact of the pandemic on the financial well-being of participants also came to light as expressed by a participant from the UK “...So my professional life was most affected meaning my teaching, my research work (#3). Another participant also said “I work for a construction company and the number one thing that was affected was our day-to-day site operations (#1, UK). The interview data also highlighted the pandemic's impact on the citizens' mental well-being. A participant said – “Oh physically I was good, but then my mental health was affected” (#11, US). Some of the participants also shared their experiences on the impact of the pandemic on their psychological and emotional well-being. Therefore, the citizens' motivation for adapting digital technologies during the pandemic was to achieve resilience after COVID struck in terms of their mental, social, health, physical, emotional, psychological, economic and financial well-being.

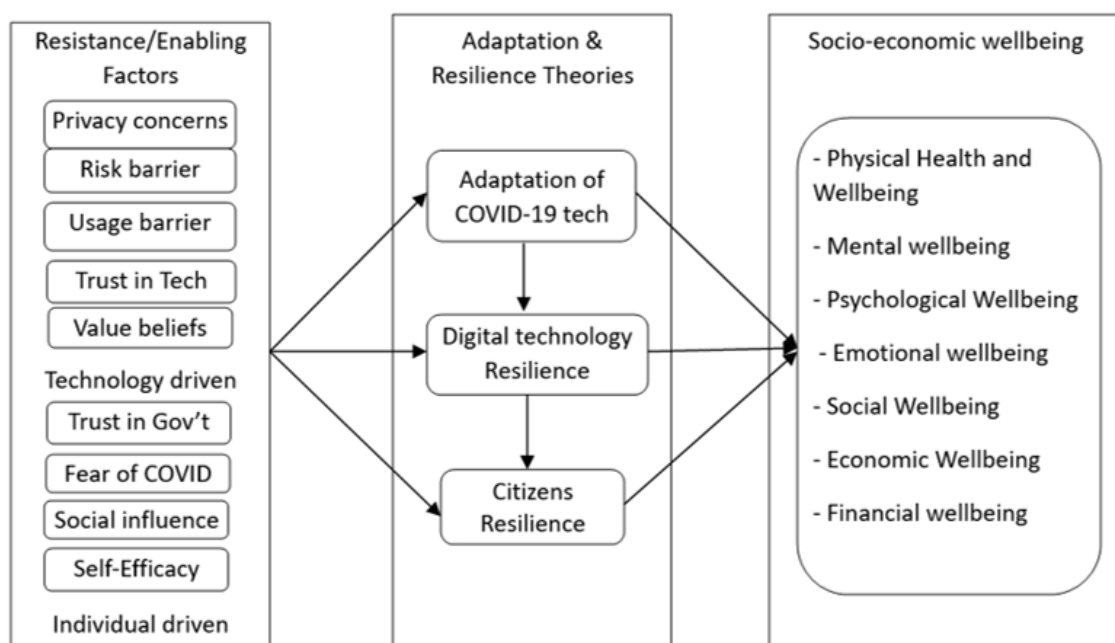


Fig. 2: Initial model of the DigiRES framework

IV. CONCLUSION

The project investigates how individuals adapted digital technologies to cope with the negative effects of the COVID-19 pandemic in their personal and public life. The aim is to develop a digital resilience framework for future pandemics based on the lessons learned from the recent COVID-19 pandemic. The analysis of the literature and the initial interviews revealed that most of the digital technology interventions adopted and/or adapted to mitigate the pandemic focused mainly on dealing with work, education, healthcare and mental health issues. The data for the study revealed several factors which the researchers categorised as resistance/enabling factors that impact citizens' digital resilience and their well-being. This is informed by the qualitative analysis of literature and interviews with citizens in the G7 countries on the lessons learned in using digital technologies during the COVID-19 pandemic leading to the model of the DigiRES framework (Fig. 2).

A limitation of this study, however, is the limited sample size and the interviews' scope. With only 18 participants from the G7 countries, the study's findings are considered comprehensive and generalizable across all G7 nations at this stage. This limited sample size hampered the ability to draw broad conclusions about digital resilience during the pandemic. Consequently, the researchers have since engaged with and interviewed individuals and organisations in the G7 countries. The researchers are targeting at least 24 participants in each country. This is expected to lead to a refined conceptual model which will be validated with a large survey. The plan is to test a series of hypotheses and develop models to predict citizens' intentions to adopt the proposed DigiRES framework in future pandemics. In doing so, the researchers expect to incorporate a cultural dimension into the framework that can help policymakers and organisational decision-makers provide more targeted digital interventions in future emergencies.

A theoretical contribution which has emerged from the research, and which we intend to develop further, consists of a novel pattern of technology adoption/adaptation that takes the context of use into account. From our findings (so far), it has emerged that individuals relate to the same technology (for example, videoconferencing) in different ways depending on whether they are experiencing an emergency (like a pandemic) or ordinary work-life. For example, individuals may lament the continuous use of digital technologies when experiencing a lockdown, but then they may prefer adopting the same technologies more often than not once the emergency is finished. The researchers would like to investigate this theoretical implication further. Given that the researchers relied on the Scopus database for the literature search and analysis, efforts have since been made to include other databases such as Web of Science and PubMed to ensure good coverage and data robustness.

In terms of pathways to impact, among the interviewees, there has been a keen interest by participants working in information technology (IT) roles (e.g., cybersecurity and IT planning officers) who wish to be informed of the research outcomes and the resulting Digital Resilience (DigiRES) framework for future pandemics. We plan to work with these individuals to promote the framework once the project is finished. The researchers also intend to engage with policymakers of different G7 countries (and countries outside of the G7), starting from the UK, to present our research outcomes and advise on ways to address and deliver digital interventions during crises.

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