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Influence of Government Innovation Initiatives on Responsive E-governance: An Empirical Analsysis on Government Response to COVID-19 Pandemic in Pakistan

SYED ASAD ABBAS BOKHARI & SEUNGHWAN MYEONG

Abstract Numerous segments of society have been affected by the global Covid-19 pandemic. It has heralded a new era oriented toward the digitization of Pakistan after the shutdown of public sector institutions and disruptions in governance implementations. The objective of this study is to investigate how governments' innovation initiatives enhance government response to cope with Covid-19 with the primitive mechanism of citizens' adoption intention behavior during the pandemic. Employing a structural equation model in SmartPLS, data samples collected from 663 followers of social media accounts of government information department through a self-administered survey questionnaire were examined. The findings indicated a direct and indirect relationship between governments' innovation initiatives and responsive e-governance, intending to adopt e-services acting as a mediator. Similarly, the quality of government information was found to influence citizens' willingness to adopt e-services by interacting with innovation initiatives. Institutions and policymakers can benefit from the study's strategic and practical recommendations.

Keywords: • innovation initiatives • responsive e-governance • covid-19 pandemic • adoption intention • government information quality

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1 Introduction

Throughout the initial quarter of the year 2020, governments fought against an unprecedented health crisis globally: the dissemination of the COVID-19 pandemic. Along with the challenges faced by the public health sector, this period has been marked by economic breakdowns, temporary social and governmental re-organization, the protection of personal data, and the use of apps to not only track and trace contact information of presumably infected patients (Anguera-Torrell et al., 2021) but also to provide services at their doorstep. Hence, governments have taken innovative initiatives to tackle such wicked challenges (Peters & Tarpey, 2019), and serve the public, and develop data protection strategies (Zuiderwijk et al., 2016). The Covid-19 pandemic has confronted the technological discrepancy in the governance systems and contributed to the collapse of government entities (Huang, 2020). This turmoil has prompted the adoption of technology to facilitate the rebuttal. Technology-savvy South Korea has virtualized its government (Korea, 2020). Emerging economies like Pakistan differ greatly. Pakistan's government bureaucracy and traditional processes have hampered technological development (Salman et al., 2023). With the COVID-19 pandemic, government discrepancies are evident. Nevertheless, the pandemic brought modern technology to Pakistan (Sumra et al., 2022).

To combat the threat posed by the Covid-19 pandemic, several countries have launched various initiatives. To meet the expectations of the public, it is necessary to implement policies and strategies efficiently through any of the inclusive governance systems (van Ooijen et al., 2019), such as collaborative governance (Mao, 2020), which involves participation from a variety of sectors, sound governance (Farazmand, 2017), which combines the normative, technological, and rational characteristics of good quality governance, and good governance (Beshi & Kaur, 2020), which is based on responsiveness, accountability, and transparency, employing those government initiatives. In Pakistan, numerous innovative initiatives have been taken to establish collaboration between different levels of government and communities to encourage citizens to adopt digital technologies. Although the smart lockdown imposed restrictions on the movement of inhabitants and strict restrictions on inter-personal contacts, this era provided an exceptional opportunity for the government of Pakistan to establish innovation platforms and initiatives, such as the Ehsaas Program, E-Sahulat, Tax Asaan, and the Presidential Initiative for Artificial intelligence and Computing (PIAIC) (Amin & Maq, 2021; Fernández Robin et al., 2014).

The goals of digitization could be achieved by developing a knowledge-based economy and digital infrastructure. Pakistan's telecommunications infrastructure indicator (0.243) is weak compared to regional and global leaders like Liechtenstein (1.00), Korea (0.968), and Iran (0.621) (ECONOMIC & DESA., 2020). Despite

Pakistan's low telecommunications infrastructure index and volatile economy, this development marks the beginning of a new era of technology use in the government sector, where cutting-edge technologies can replace humans in service delivery. This study begins by discussing the government sector's destruction from the COVID-19 pandemic and its innovation initiatives aimed at mitigating it. It then discusses technological development barriers and an innovative governance framework to overcome them. The COVID-19 pandemic had shown that Pakistan's governance systems are flawed, but it also highlighted the need to digitize the government sector and use innovative technologies to improve governance (Mansoor, 2021).

Due to its communication, engagement, and involvement, social media has become one of the most popular digital channels for information sharing, with 2.62 billion monthly active users in 2018 (Statista, 2018) and 4.3 billion in 2021 (Tang et al., 2021). Due to social media's centralized dominance, developed countries' governments have capitalized on it, increasing its popularity (Park et al., 2016). In contrast, developing countries public use social media more for recreation, but governments use it for news, information, and announcements (Mansoor, 2021). 35 million Pakistanis have been using social media monthly (Arshad & Khurram, 2020). Pakistani governments and political parties have recently started using social media to share state-level decisions. Though social media is young, the government recognizes its importance (Memon et al., 2015). Pakistan's then-prime minister Imran Khan frequently used social media platforms to interact with citizens and announce important government decisions during the COVID-19 pandemic.

This study is novel because it integrates several theories in a single framework and employs the human-machine innovative governance framework by using the diffusion of innovation theory (Mahajan & Peterson, 1985), technological interdependence theory (Ertur & Koch, 2007), and the technology acceptance model (King & He, 2006) to contribute insights into (i) how the Pakistan governments' innovation initiatives impact responsive e-Governance; (ii) how technology adoption behavior for e-services is influenced by governments' innovation initiatives and further impacts responsive e-Governance; (iii) mediating impact of government's adoption intention between innovation initiatives and responsive e-Governance; (iv) the effect of governments' information quality (GIQ) in responsive e-Governance; and (v) moderating role of governments' information quality on the relationship between innovation initiatives and adoption intention as well as on the relationship between adoption intention and responsive e-Governance in Pakistan.

The study continues with the following structure. In Section 2, we reviewed the relevant literature, developed hypotheses, and empirical framework. Section 3 presents the research methodology. The study's outcomes are summarized in

Section 4. Sections 5 and 6 then present the study's limitations, potential future research directions, and practical recommendations for public administrators based on the study's outcomes and the study's contributions to the existing research.

2 Literature overview

2.1 Underpinning Theories

The *theory of Innovation diffusion* seems to related for this study (Mahajan & Peterson, 1985). This theory assumes that service or product innovations lead to technological and economic success and I nnovation improves infrastructure and services. It then lists five types of innovation: new services, production methods, supplies, applications, and organizational models. The prevailing situation in Pakistan is a good match for the theory. The COVID-19 pandemic has crippled public service delivery. Pakistan can only modernize its government and create new economic opportunities by adopting innovation (Memon et al., 2015). We propose that government innovation initiatives are more likely to inform citizens about new online services. When citizens trust the government's high-quality information about its services, they'll adopt new technologies that will help the government to improve governance. Pakistan's public sector innovation has been extensively studied (Salman et al., 2023; Szkuta et al., 2014). Scholars argued that the public sector should change its organizational system, decision-making processes, and service delivery structures by considering innovative technologies. They argue that public sector technology innovation drives economic growth and responsive e-Governance.

The *theory of technological interdependence* can also be applied to the study's primary hypotheses. It suggests that an institution's departments work together to perform their duties well (Bailey et al., 2010). Three technological interdependence types are stressed. "Pooled interdependence" refers to the simplified form of interdependence, where different departments in an institution work independently. "Sequential interdependence" implies one segment completes an assignment before moving on to the next segment in the channel. Bilateral interdependence supports moderate coordination between an institution's components. Since COVID-19 devastated the region, Pakistan's governance framework, characterized by limited or nonexistent cooperation between institutions, is well encapsulated by pooled technological interdependence (Bajwa et al., 2018). Through advanced smart technologies, Pakistan's government institutions should be highly interdependent.
The *technology acceptance model* empowers innovation research and institutional technology adoption (Sahin, 2006). Innovative technologies that are useful and easy to use are more likely to be adopted (Fernández Robin et al., 2014). It also identifies the top five questions to assess a company's employees' technology adoption. These questions are, "Does it have a comparative advantage?" Is there any way to test it

out before committing to it? Are there any issues about it being utilized in a professional context? Just how sophisticated is it? Can we actually see it? Pakistan's government should answer these questions before adopting innovative technologies. The technology acceptance model can revolutionize Pakistan's governance system and achieve e-governance and digitization. Pakistan trails regional and global leaders in e-government development like Norway (0.976), the Republic of Korea (0.956), and Sri Lanka (0.671) (ECONOMIC & DESA., 2020).

2.2 Influence of Government' Innovation Initiatives

2.2.1 Innovation initiatives to Responsive e-Governance

Government innovation strategies and initiatives influence e-Governance, according to the prior studies (Ludwig & Macnaghten, 2020). Governance has been applied as an independent variable (Mansoor, 2021), dependent variable (Omoding et al., 2020), mediating variable (Huang et al., 2021), and a moderating variable to investigate the relationship between innovation and e-service delivery (Bokhari & Myeong, 2022). Governments' innovative initiatives like Pakistan's "Ehsaas program" provided underprivileged citizens access to a smartphone-based bank account, financial inclusion, and protection from corrupt financial abuses by utilizing a properly biometric payment platform to provide secure, digital cash transactions all across Pakistan (Ashfaq & Bashir, 2021). Similarly, Pakistan's government launched a smartphone application with easiest features named "Tax Asaan" for web-based tax return filing, enabled citizens avoid visiting the domestic Federal Board of Revenue office (Akram et al., 2019). E-Sahulat was another government innovation initiative. NADRA, a government body, developed a prepaid e-Sahulat deposit and withdrawal platform to pay utility bills and make digital transactions after biometric and CNIC verification to bridge the "Service-Divide" between rural and urban Pakistanis (Hassan et al., 2020).

In response to COVID-19, the government of Pakistan adopted these innovation initiatives and made it possible for citizens to obtain services online while remaining in the convenience of their own homes during lockdown and quarantine. Hence, we proposed the following hypothesis.

Hypothesis 1: Governments' innovation initiatives are positively associated with responsive e-Governance

2.2.2 Innovation initiatives for governments' Information quality

Information sharing on social media for innovation usually discusses about process innovation (Reddick & Norris, 2013), product innovation (Ghezzi et al., 2016), open innovation (Piezunka & Dahlander, 2015), technical innovation (Yuan et al., 2023),

marketing innovation (Bhimani et al., 2019), service innovation (Khan & Khan, 2019), and organizational innovation (Muninger et al., 2019). Social media can spread information about innovations through two-way cooperation for indea development, communication forums, broadcasting relevant information, finding emerging issues, publicizing collaborative efforts, and motivating citizens to participate in innovation initiatives (Chatterjee et al., 2021).

Previous scholars proposed a framework for evaluating government social media activities based on transparency, participation, and collaboration to understand how platforms may assist information sharing (Criado et al., 2013). Unique aspects of government innovation prioritize information sharing in government institutions' processes to improve public understanding (Zheng & Zheng, 2014). In a study on social media in government, Mergel argued that smart use of information and communication technology (ICT) tools could improve government efficiency and accelerate the formulation of innovative policies (Mergel, 2012). Social media can also foster an innovation-focused culture in government institutions (Roberts et al., 2016). Additionally, a democratic government must appreciate public feedback and pursue public confidence (Purwanto et al., 2020). Given its prevalence, social media is being used as a promising strategy to boost government innovation (Bhimani et al., 2019). By posting comments and sharing information on social media, the citizens can observe government institutions' innovation (Muninger et al., 2019). Thus, the above literature supports the hypothesis:

Hypothesis 2: Governments' innovation initiatives are positively associated with governments' quality information dissemination through social media

2.2.3 Innovation initiatives to adoption intention

In previous studies, perceived usefulness and ease of use were among the most important factors influencing people's adoption of new technologies to get services (Al-Emran & Teo, 2020). If people think that innovation overlaps with how they performed things previously, they are less confident in its benefits (Phang et al., 2005). In this study focused on Pakistan, the COVID-19 pandemic pushed government sector digitalization despite its devastating effects on the economy and society (Amin & Maq, 2021). Citizens have pursued public service alternatives due to government entities shutdowns. Thus, Covid-19 promoted internet usage and new technologies. Government also developed several portals and online applications. The online portals and applications were primarily implemented in the education sector (Abid et al., 2021), healthcare sector (Ullah et al., 2021), disaster management (Mahnaz Hassan, 2021), service sector(Amin & Maq, 2021), and financial sector (Hassan et al., 2020). Virtual education replaced on-campus learning, online healthcare replaced traditional healthcare systems, emergency cash payments using biometrics, utility bill payments and e-transactions, and online tax

return filing were provided using technologies. Since the March 2020 lockdown, internet traffic has increased 15%, according to the Pakistan Telecommunications Authority. Only tax return filing, utility bills payment, and e-transactions have seen unprecedented growth (Hamza Quddus et al., 2022). Literature shows the country's innovation adoption is escalating. The following hypothesis is derived from the existing literature, suggesting that citizens will adopt the easy and usefull e-services offered.

Hypothesis 3: Governments' innovation initiatives are positively associated with citizens' adoption intention

2.3 Influence of Government Information Quality on responsive e-Governance

High-quality information shared on social media will assist the public understand how the government is responding the COVID-19 pandemic (Mansoor, 2021). In research on social media and government, previous scholars argued that the adequate use of information and communication technology (ICT) could improve government effectiveness and accelerate the development of innovative policies to best control public grievances, both of which are indicators of e-governance (Todisco et al., 2021). Other researchers stated that government institutions' social media utilization promotes a culture of responsiveness (Jing, 2021). The democratic government also must appreciate public feedback and pursue public confidence (Purwanto et al., 2020). Social media's dramatic growth is making it a valuable resource to assist the government in solving citizens' problems (Arshad & Khurram, 2020). Several scholars suggested that government shares information and citizens can directly comment on social media platforms, depicting how responsive government institutions are to Covid-19 through technology (Liao et al., 2020). Hence, this literature supports the hypothesis:

Hypoyhesis 4: Governments' high-quality information is positively associated with responsive e-Governance

2.4 Influence of Adoption Intention on Responsive e-Governance

E-Governance requires government innovation initiatives and citizen adoption. Adoption is "a simple decision of using, or not using, online services," as defined by (Upadhyay et al., 2022). Previous research found that 15% of e-government projects succeeded, 35% failed, and 50% struggled. Most of these failures occured in emerging economies (Mansoor, 2021). E-government adoption is low worldwide. E-governance adoption is below 30% in Ireland, Poland, and Kuwait and around 50% in Australia, Canada, and Finland (Upadhyay et al., 2022). Despite their success in several developed nations, e-government services have potential for

expansion. E-governance, like all other innovations, challenges citizens and governments (Mensah et al., 2020). The generation gap, a lack of trust in government websites and apps, and security concerns hinder e-government services adoption (Goldfinch et al., 2021). In 2020 and 2022 UN e-government global surveys, Pakistan ranked 153 and 150 respectively. Considering this, most governments struggle with low e-services adoption and technology usage. By identifying the factors that discourage technology adoption for e-government services, Pakistan may attract a large number of citizens (Shah et al., 2019). According to the literature, global citizens' adoption intention to use e-government services faces challenges. Hence, We hypothesized:

Hypothesis 5: Citizens' adoption intention is positively associated with responsive e-Governance

2.5 Mediation Effects

2.5.1 Mediation Effect of Governments' Information Quality

Previous literature discovered the impact of governments' innovation on the ways government institutions responded to calamities (Izumi et al., 2019) and the COVID-19 pandemic (Sarkar, 2021). Moreover, Government innovation activities also improved government information (Park et al., 2016). Several scholars revealed that government information quality predicts technology-based Covid-19 response (Ludwig & Macnaghten, 2020). Furthermore, Previous several previos studies applied government information quality shared on social media as a moderator (Mansoor, 2021). Due to the novelty of this relationship, the literature on how government information quality affects government innovation initiatives and responsive e-Governance is lacking. To improve government response to the pandemic, it's important to examine how the public's narrative of governments' innovation initiatives affects government information. Thus, to fill gaps in the literature, good governance theory suggests that government institutions must respond quickly to public concerns to establish responsive e-Governance, we develop our hypothesis as:

Hypothesis 6: Governments' high-quality information mediates the association between governments' innovation initiatives and responsive e-Governance

2.5.2 Mediation Effect of Adoption Intentions

The success of e-governance largely depends on the government's innovation capabilities (Meijer, 2015). The term "government innovation" is described as the implementation of innovative systems in the government sector to facilitate strong connectivity between government institutions and the citizens

to streamline administrative processes (Criado et al., 2013). Failing to provide timely public services can result in conflict and lack of trust, which can stimulate turmoil and sometimes even defiance among the population, making government innovation much more essential (Saha et al., 2010). To increase citizens' interest in adopting these technologies, public institutions have started to provide a wide range of services electronically (Beshi & Kaur, 2020). In addition, the dissemination of information via social media has made it convenient for citizens to comprehend the importance of several government services (Zheng & Zheng, 2014). Previous studies have demonstrated a correlation between government innovation and citizens' technology adoption intention (Hassan et al., 2020; Mansoor, 2021), and citizens' technology adoption intention has a direct effect on e-governance (Upadhyay et al., 2022). However, the underlying mechanism through which this causal relationship is established remains unclear. To the best of the authors' knowledge, adoption intention is rarely used as a mediator variable, despite its widespread usage as an independent variable (Gupta et al., 2020), dependent variable (Zhao et al., 2018), and moderating variable (Rahman et al., 2020). Thus, to address this research gap, based on the technology adoption model, which asserted that individuals would exhibit an intention to adopt a technology if they found it to be both useful and easy to use, we developed the following hypothesis:
Hypothesis 7: Citizens' e-services adoption intention mediates the association between governments' innovation initiatives and e-Governance.

2.6 Moderation Effect

2.6.1 Moderation Effect of Governments' Information Quality on Social Media

Social media provides citizens with trustworthy government information, which increases their long-term adoption intention of e-Government services (Hassan et al., 2020; Zheng & Zheng, 2014). Governmental innovation programs may use new technologies, which may increase citizens' willingness to adopt them (Al-Emran & Teo, 2020). Moreover, the government's timely and efficient response to the COVID-19 pandemic using e-government tools is connected to a high technology adoption intention among citizens (Shah et al., 2019; Upadhyay et al., 2022). Arshad and Khurram (2020) identified that citizens' adoption intentions were increased when they were informed of government initiatives through social media, a reliable information source. Another group of scholars argued that when government institutions share helpful information on e-government social media platforms, the audience gets a better image of the government's actions that were taken for the betterment of their people, leading to higher technology adoption intention from citizens and better government response in disaster situations (Beshi & Kaur, 2020; Mansoor, 2021). Other researchers examined the correlation between citizens' adoption intention level and the government's response to Covid-19 using

technologies and found promising results by focusing on the government's two information dissemination methods, social media and e-government websites (Phang et al., 2005).

COVID-19 has also hampered society and traumatized socio-economic initiatives worldwide, though debate continues. Pakistan responded well to the COVID-19 pandemic despite resource constraints. "The Economist" ranked Pakistan third in pandemic management after Hong Kong and New Zealand (Khan et al., 2022). Pakistan launched the Ehsaas Program to provide social security and reduce poverty after the pandemic. Pakistan's prime minister, Imran Khan, has called it a crucial step toward creating a welfare state that empowers the poor, reduces inequality, and revitalizes its impoverished regions (Mahnaz Hassan, 2021). The first step was mobilizing technology at different administration levels and providing grassroots resources. The federal disaster agency is also activated. Tax asaan and E-Sahulat promoted e-government services via mobile apps via social media. Risk control was unclear despite these departments. Since the collaborating institutions were formed, transparent and equitable communications have begun, and all government levels collaborate daily for the first time (Arshad & Khurram, 2020). The local administration helped nationwide COVID-19 standard operating procedures, country management, and social distancing. Social media's response to new challenges made all these initiatives possible (Mansoor, 2021).

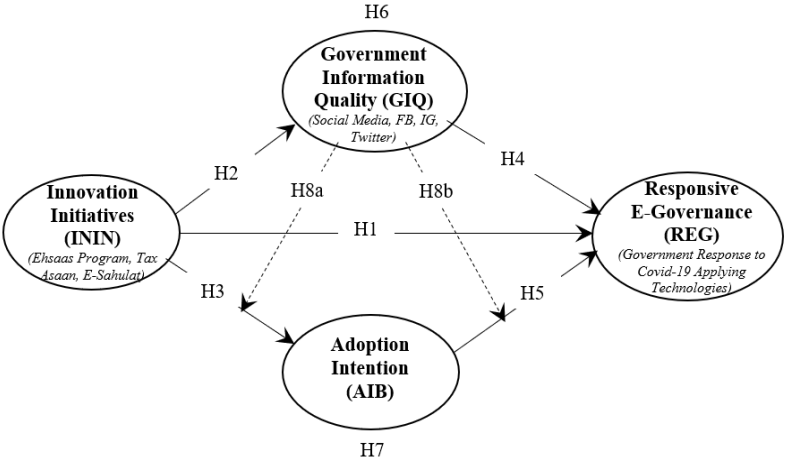
Senior-level administration including chief ministers of all provinces, kept the public informed about their initiatives on a continuous basis through the government institution PID, social media, and other media outlets. As a result, improved health practices were implemented quickly, and the public's confidence in the government was revived after a period of turmoil (Mansoor, 2021). Thereby, considering the aforementioned perspectives, government initiatives, and the literature gap exploring the effects of the interaction effect of ININ and GIQ on citizens' adoption intention of technologies, and the interaction effect of AIB and GIQ on responsive e-Governance, it is proposed that:

Hypothesis 8a: Governments' information quality provided on social media moderates the association between governments' innovation inititiatives and citizens' e-services adoption intention such that the association will be strengthened when high-quality information will be provided by the government on social media.

Hypothesis 8b: Governments' information quality provided on social media moderates the association between citizens' e-services adoption intention and responsive e-Governance such that the association will be strengthened when high-quality information will be provided by the government on social media.

This study's conceptual framework is illustrated in Fig. 1.

Figure 1: Conceptual Framework of Innovation, Technology, Information, and Responsive e-Governance



3 Research Methodology

3.1 Sampling and Data Collection

This study empirically investigated the conceptual framework by using a self-administered survey to assess public perception, beliefs, and behaviors without researcher meddling, biases, or exploitation (Fernández Robin et al., 2014; Mansoor, 2021). The authors contacted 960 Press Information Department (PID) followers on Instagram, Twitter, and Facebook to briefly explain the study purpose. The authors used followers of PID as a representative sample of the population in order to gather data, as PID was the exclusive department deployed by the government to disseminate information pertaining to government services and quarantine measures during the Covid-19 pandemic. There were 1.6 million people who followed the PID Instagram page as of January 10, 2023, 3.0 million on Twitter, and 660,000 people who followed the PID on Facebook. The authors applied a random selection process to identify the most active social media users who frequently engaged with government information posts through actions such as liking and commenting. The participants were delivered an online questionnaire with four main sections: demographics, two broad questions about the respondents' frequency of social media use, the duration of PID following, and questions about all research constructs evaluated on a 5-point Likert scale. All questions were "required," which required participants to complete the survey form and eliminated

missing values. 706 responses were received, but 43 were dispassionate and eliminated from evaluation. The final analysis included 663 responses, a 69.06% response rate. Among the survey respondents, 62.43% of respondents were men, 45.28% were between the ages 18–35, 47.43% of respondents had a bachelor's degree, 29.54% actively employed, and 37.67% stated that they have been using social media for 1–3 years. These findings suggest Pakistani youth are more engaged with social media and government news. Due to its diverse demographics, this study's sample is representative of the general population.

3.2 Study Measurements

The participants in the study were surveyed using a 28-item survey questionnaire (Appendix A). A "five-point Likert scale" was employed to rate all of the items. A five-item scale adapted to the survey of innovation initiatives (Lawson-Body et al., 2014). Statements about the government's innovative initiatives like E-Wallet, Tax Asaan, and E-Sahulat, which enable citizens to undertake activities like receiving emergency cash, paying utility bills, and filing tax returns from their smartphones, are included on this scale. Nine items were measured on adapted scales to evaluate the degree to which people had adopted different technologies (Fernández Robin et al., 2014). Questions on the scale investigate respondents' perceived usefulness, ease of use, and trust in technology and the government. The quality of government departments' information provided on social networks was measured using a seven-item scale adapted from (Park et al., 2016) and included statements about the accuracy, frequency, timely delivery, and diversity of information provided by the government departments on social media. Finally, Perceived responsiveness (Vigoda-Gadot & Yuval, 2003), perceived accountability (Alam & Said, 2015), and perceived transparency (Park & Blenkinsopp, 2011) were adapted and employed to evaluate responsive e-Governance on an eight-item scale. Perceived responsiveness was measured by statements about the government's consideration for its residents and proactive delivery of information; perceived accountability was measured by assertions about the government's adherence to rules and guidelines to serve the public interests; and perceived transparency was measured by statements about the government's provision of clear, accessible, and transparent information.

4 Study Findings

4.1 Measurement Model Assessment

Confirmatory factor analysis using SmartPLS 4.0 was executed to evaluate the indicators' measurement scale. Following the recommendations of previous scholars, we employed “composite reliability” (CR) and “Cronbach's alpha” (α) to examine the reliability of the instruments (Henseler et al., 2015). The scores of CR and "Cronbach's α" (>0.70) in Table 1 demonstrate the reliability of all the reflective measures. “Convergent and discriminant validity” was further evaluated. All predictor factors appear to have factor loadings of > 0.60, with each factor loading significantly ($p < 0.001$) upon its construct validity (Fig. 2). Further, the "Average Variance Extracted" (AVE) of the latent variables was less than 0.50 across all constructs, indicating that convergent validity had been accomplished (Hair et al., 2010). Finally, Heterotrait-Monotrait (HTMT) ratio was analyzed as an appropriate estimation of discriminant validity to investigate convergent validity (Henseler et al., 2015). Findings in Table 1 illustrate that all of the HTMT scores were below 0.9 as suggested by previous studies (Hair et al., 2010).

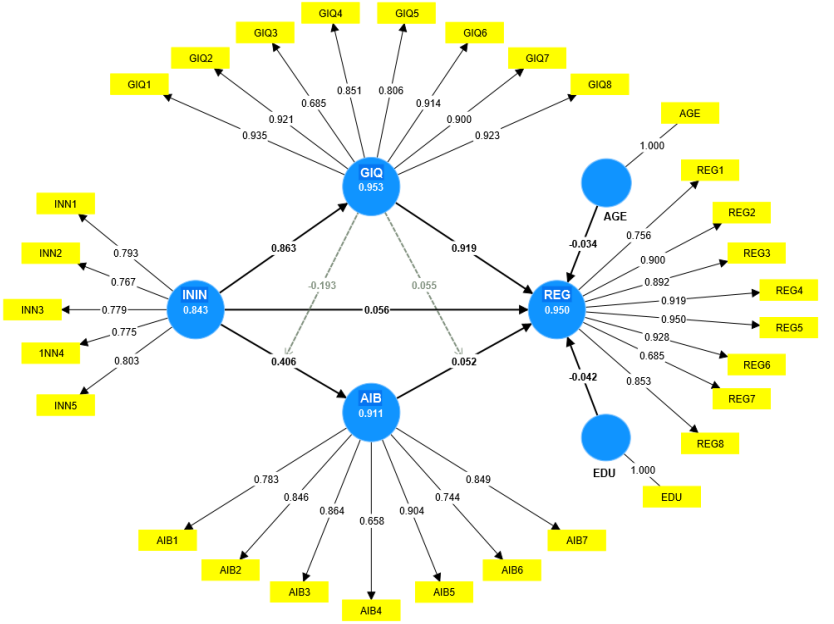
Table 1: Measurement Model Findings

Variables	Items	N	Factor Loadings	VIF	α	CR	AVE	HTMT
Innovation Initiatives	ININ1 <- ININ	663	0.789	2.098	0.843	0.845	0.614	0.783
	ININ2 <- ININ	663	0.779	1.584				
	ININ3 <- ININ	663	0.722	2.343				
	ININ4 <- ININ	663	0.772	2.475				
	ININ5 <- ININ	663	0.814	1.657				
Adoption Intention	AIB1 <- AIB	663	0.783	1.531	0.911	0.920	0.657	0.810
	AIB2 <- AIB	663	0.846	2.116				
	AIB3 <- AIB	663	0.865	1.812				
	AIB4 <- AIB	663	0.657	2.323				
	AIB5 <- AIB	663	0.904	1.712				
	AIB6 <- AIB	663	0.745	1.938				
	AIB7 <- AIB	663	0.848	0.923				
Government Information Quality	GIQ1 <- GIQ	663	0.935	1.954	0.953	0.962	0.758	0.870
	GIQ2 <- GIQ	663	0.922	2.035				
	GIQ3 <- GIQ	663	0.685	1.922				
	GIQ4 <- GIQ	663	0.849	1.712				
	GIQ5 <- GIQ	663	0.804	1.938				
	GIQ6 <- GIQ	663	0.915	1.531				
	GIQ7 <- GIQ	663	0.901	2.116				
	GIQ8 <- GIQ	663	0.925	2.177				
Responsive e-Governance	REG1 <- REG	663	0.755	1.371	0.950	0.960	0.748	0.864
	REG2 <- REG	663	0.901	1.545				
	REG3 <- REG	663	0.893	1.804				
	REG4 <- REG	663	0.919	1.558				
	REG5 <- REG	663	0.950	2.064				
	REG6 <- REG	663	0.928	1.812				
	REG7 <- REG	663	0.685	2.412				
	REG8 <- REG	663	0.853	2.382				

4.2 Structural Model Assessment

The full model findings demonstrate a good fit between the data and the framework. The conceptual model's multicollinearity was examined by computing VIF values initially. As illustrated in Table 2, all VIF values had been below the optimal threshold of 5, indicating that multicollinearity was maintained to a minimum across all sets of estimator relationships in the conceptual framework. After that, we performed an omission distance = 7 blind test of PLS path modeling. Predictive significance values for Q2 which are higher than 0 indicate that the underlying conceptual framework is satisfactorily reflective. In contexts of out-of-sample forecasting, as displayed in Table 3, the PLS path model has the adequate predictive ability (Hair et al., 2010). Coefficient of determination (R2) scores lends further credence to the Q2 forecasting significance findings.

Figure 2: Full Measurement Model Portraying the β values and Construct Factor Loadings



Moreover, a preliminary analysis was undertaken to assess the conceptual framework for "normality, linearity, and homoscedasticity". Table 2 displays that the data were normally distributed as determined by the skewness and kurtosis of the survey instruments. The skewness values were constricted ranging between -0.852 and 0.616, and the kurtosis values were restricted ranging between -1.421 and

0.349, both falling within the 2.00 and +2.00 interval. These findings indicate that the data sample employed in this research did not have any concerns with skewness or kurtosis. Also, the linearity of the proposed conceptual framework was validated by examining the appropriate plots for each residual of the regression and scatterplot. According to the results of preliminary analyses, the data sample used in this research proves to be normal, linear, and homoscedastic.

Table 2: Descriptives, Mean, Standard Deviation, and Correlations

	Mean	SD	Kurtosis	Skewness	VIF	Inn	Tech Adopt	GIQ
ININ	3.98	0.623	0.349	0.616	1.567	1		
AIB	4.17	0.737	-0.211	-0.852	1.362	0.934**	1	
GIQ	3.76	0.528	-1.421	-0.360	2.314	0.858**	0.926**	1
REG	3.94	0.634	-1.304	-0.319	1.743	0.865**	0.928**	0.997**
R^2 for e-Governance	*0.996*		*R^2 for Adoption Intention*		*0.948*	*R^2 for Information Quality*		*0.743*

Note: Significance levels: p<0.05*; p<0.01**; SD = Standard deviation

4.3 Overall Model Fit

For PLS path modeling, the SRMR (standardized root mean square residual) measure was also applied to assess overall model fit (Henseler et al., 2015). The model-implied correlation is utilized to evaluate the SRMR, which is described as the "root mean square discrepancy between the observed correlations and the observed correlation" (Hair et al., 2010). When the SRMR would be below 0.08, the model fits the data adequately. Overall, the PLS path model had a model fit with an SRMR of 0.07.

4.4 Hypotheses Testing – Direct Effects

Table 3 summarizes the findings, which exhibit a positive and statistically significant influence of ININ on citizens' perceptions of REG ($\beta = 0.056$, $t = 3.884$, $p < 0.01$), on the GIQ ($\beta = 0.863$, $t = 75.341$, $p < 0.01$), and AIB ($\beta = 0.406$, $t = 13.074$, $p < 0.01$). Findings further revealed that the GIQ has a positive and substantial influence on REG ($\beta = 0.919$, $t = 50.142$, $p < 0.01$). Similarly, REG was also discovered to be significantly influenced by the citizens' AIB ($\beta = 0.052$, $t = 2.756$, $p < 0.01$). Consequently, the findings provide strong support for hypotheses: H1, H2, H3, H4, and H5. To evaluate, the path coefficient model on REG had an R2 of 0.997, the direct impact of INN on GIQ had an R2 of 0.744, while the direct impact of INN and AIB had an R2 of 0.946. Table 4 further shows that in the PLS path model, control variables such as age and education had negative, statistically significant effects. In particular, both age ($\beta = -0.034$, $t = 5.902$, $p < 0.01$) and

education (β = -0.042, t = 4.864, $p < 0.01$) levels were negatively associated with REG. Previous studies that used similar methods demonstrated similar outcomes for the control variables (Al Athmay, 2015; Gupta et al., 2018).

Table 3: Structural Equation Modeling Findings

	Original sample (O)	Sample mean (M)	Standard deviation	T statistics (|O/STDEV|)	P values	Results
AGE -> REG	-0.034	-0.033	0.006	5.902	0.000	Supported
EDU -> REG	-0.042	-0.043	0.009	4.864	0.000	Supported
ININ -> REG	0.056	0.057	0.014	3.884	0.000	Supported
ININ -> GIQ	0.863	0.865	0.011	75.341	0.000	Supported
ININ -> AIB	0.406	0.401	0.031	13.074	0.000	Supported
GIQ -> REG	0.919	0.919	0.018	50.142	0.000	Supported
AIB -> REG	0.052	0.051	0.019	2.756	0.006	Supported
GIQ -> AIB	0.492	0.498	0.022	22.009	0.000	Supported
GIQ x ININ -> AIB	-0.193	-0.192	0.027	7.231	0.000	Supported
GIQ x AIB -> REG	0.055	0.055	0.007	7.352	0.000	Supported

4.5 Mediating Effects

Findings of the indirect effects of this study are displayed in Table 4, which demonstrates that the mediation hypotheses H6 and H7 are all supported with evidence. The GIQ was identified to be a mediating factor between INN and their effects on REG (β = 0.793, t = 42.226, $p < 0.01$) and on citizens' AIB (β = 0.021, t = 2.492, $p < 0.01$). Further, in the existence of AIB as an underlying principle, a positive indirect impact of INN on REG was found (β = 0.425, t = 19.763, $p < 0.01$), as was a positive indirect impact of GIQ on REG (β = 0.026, t = 2.863, $p < 0.01$), but these associations were not hypothesized. Last but not least, the GIQ and the AIB were found to have a positive multi-indirect effect (β = 0.022, t = 2.869, $p < 0.01$) on REG (Fig 3). Provided these findings, it may be concluded that mediation hypotheses H6, and H7 are supported satisfactorily.

4.6 Moderating Effect

PLS-SEM technique and interaction terms between the moderating variable governments' information quality and the predictor variable innovation initiatives were developed to examine the moderating effect (Chin et al., 2003). The findings supported the moderating effects of the hypothesis. To be more precise, the findings revealed that the association between ININ and AIB was significantly influenced by the interaction terms GIQ*ININ (β = -0.193, t-value = 7.231, $p < 0.000$). Similarly, the findings discovered that the relationship between AIB and REG was

significantly influenced by the interaction terms GIQ*AIB ($\beta = 0.055$, t-value = 7.352, $p < 0.000$).

Table 4: Mediation Analysis / Specific Indirect Effects

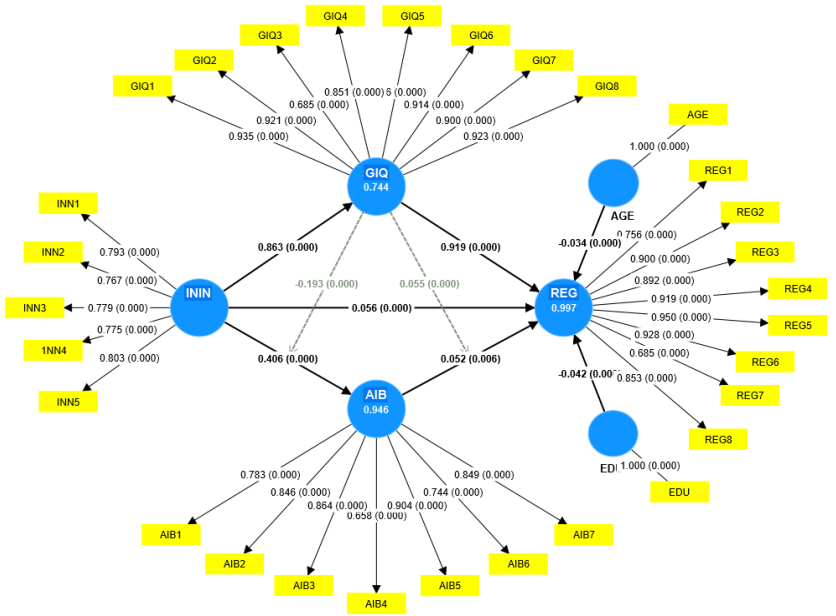
	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values	Results
ININ -> GIQ -> REG	0.793	0.795	0.019	42.226	0.000	Supported
ININ -> AIB -> REG	0.021	0.021	0.008	2.492	0.003	Supported
Non-Hypothesized Relationships						
ININ -> GIQ -> AIB	0.425	0.431	0.022	19.673	0.000	Supported
GIQ -> AIB -> REG	0.026	0.025	0.009	2.863	0.004	Supported
ININ -> GIQ-> AIB -> REG	0.022	0.022	0.008	2.869	0.006	Supported

5 Discussion

5.1 Study Findings

This study examined governments' innovation initiatives and responsive e-governance using innovation diffusion, technology adoption, and good governance theories. This was performed directly and indirectly by analyzing the relationship between government information quality on social media during COVID-19 and citizens' intentions to adopt new technology-based e-services. This study also examined how the quality of government information shared on social media during COVID-19 affected citizens' adoption intentions, government innovation initiatives, and responsive e-Governance. This investigation focused on Pakistan Information Department.

Figure 3: Structural Equation Modeling Findings portraying the substance of Hypothesized paths



The findings are consistent with the findings of (Ashfaq & Bashir, 2021; Capodistrias et al., 2022), who exhibited the significance of government-implemented innovative initiatives for responding to calamities and natural disasters by using technologies for sustainable governance, regarding the association between government-implemented innovation initiatives and responsive e-Governance.The findings were further consistent with (Gupta et al., 2018) about the relationship between government innovation initiatives and citizens' adoption intention of e-services and high-quality information shared by the government through social media. For example, revolutionary governments typically share information with citizens regarding their decisions and developments through social media during uncertain conditions, and the citizens express an intention to adopt these services. Government information quality and Covid-19 response were related (Purwanto et al., 2020) as were citizen adoption intention and responsive e-Government (Shah et al., 2019). This shows how much Pakistanis welcomed the government's pandemic technology. The government also knew that a complete lockdown would destroy the underprivileged 50% of the population, who mostly work daily (Mansoor, 2021). Lockdown and recession kept them home. Thus, the government provided that impoverished region food,

emergency cash, and healthcare, encouraging volunteerism. Locals helped the poors too.

Finally, the results showed that governments' quality information shared on social media positively impacts their innovation initiatives, adoption intention, and technology-based response to COVID-19. These findings support previous research showing that governments' quality social media information influences citizens' intentions to adopt new technologies (Arshad & Khurram, 2020) and improves responsive e-Government (Purwanto et al., 2020). When government entities share information about new technological innovations and policy changes, more individuals will adopt them (Yang & Maxwell, 2011). That's why Pakistani governments must use social media to share accurate information with their citizens to establish confidence.

5.2 Practical Implications

The study examined the mechanisms that strengthen responsive e-Government, making it useful for policy experts, legislators, public officials, and politicians. The government should innovate and make strategic decisions for the public's good. If they want citizens to adopt innovative initiatives and systems, government institutions should make good decisions on important issues and efficiently distribute such information. Innovative technologies that help governments handle disasters like COVID-19 enhance public confidence in government. Investment can accelerate economic growth by increasing citizen confidence in government decision-making. Information should be shared between government agencies. Governments and public service organizations should collaborate in order to take immediate, data-driven, and rational social action.

5.3 Theoretical Implications

This study has significant theoretical contributions. GIQ, AIB, and REG are the first and only comprehensive framework to validate the diffusion of innovation theory, good governance theory, and technology adoption model, all of which were used for decades to understand societal and political issues in various societies. This study also addressed questions about citizens' declining interest in new e-service technologies and the government's ability to use technology to respond to disasters, especially in emerging economies. The current study's inclusion of an emerging economy context illuminates the challenges and opportunities for all emerging economies, which seek innovative disaster response methods. This study also supports the mediating role of citizens' adoption intention and governments' information quality between government innovation initiatives and responsive e-Government in Pakistan, filling a critical gap in the literature. Pakistan, an emerging economy, has young social media networks. This study adds to the literature on

government innovation initiatives, citizens' e-service adoption intentions, and the timely sharing of important information on social media platforms for the public good. Governments must consistently include citizen perspectives in strategic decision-making rather than enforcing their own decisions to achieve collaborative engagement.

5.4 Study Limitations and Future Research

The study has limitations despite its implications. First, this study surveyed the social media followers of one Pakistani institution (PDI), so the findings have limited generalizability. Conversely, future scholars can study other departments' followers' opinions by analyzing their social media usage. Second, convenience sampling limited gender and occupational generalizability since most participants were male students. Quota-based sampling, where a specific proportion of each gender and occupational group is fixed and the representative sample is divided equally between males and females, can overcome this limitation. Longitudinal research may also help researchers understand the variables' relationships. Third, the sample size (N = 663) may not accurately represent the Pakistani population. A large data sample will help future researchers overcome this obstacle. Finally, the proposed association and items' reliability and validity were examined using SmartPLS 4.0, a novel statistical software. Using quantitative research of participants' viewpoints and in-depth interviews, a mixed-method approach lets scholars get to the findings and identify other potential components involved in governments' quick response to disasters using technology.

6 Conclusions

The government's primary responsibility was to implement innovative e-services that fulfilled citizens' needs, strictly enforce standard operating procedures, and strategize to prevent COVID-19 transmission and casualties. E-services have greatly improved the government's response to the COVID-19 pandemic, so citizens' intentions to adopt them were essential. Based on innovation diffusion theory, this study suggested that government sector innovation initiatives would increase the likelihood of a responsive e-Government both directly and indirectly through government-provided high-quality information and citizens' adoption intentions for e-services. This quantitative survey study examined 663 people who followed the PID's official Twitter, Instagram, and Facebook channels to determine how the government's high-quality social media information sharing moderates innovation initiatives and adoption intentions. The study's assumption and conceptual framework complement the findings. Pakistani officials utilized social media during COVID-19 without fear of repercussions. Innovative e-service users had adequate time to express their opinions. This study also supports the government's use of ICT and promotes best practices that will lead to a positive and

progressive society if government-citizen communications and interaction are managed well.

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Appendix:

Appendix A: Items to Measure Variables with Sources

Variable		Items	Source
Innovative Initiatives		e-Wallet is a good government initiative to provide emergency cash in Ehsaas Program	Self Constructed
		I can use e-Wallet anytime from anywhere using my smartphone	
		Tax Asaan is a good government initiative to get Tax related information and file income tax return in FBR	
		I can use Tax Asaan anytime from anywhere using my computer	
		E-Sahulat app is an innovative initiative to pay utility bills and perform other e-transactions	
		I can use E-Sahulat app anytime from anywhere using my smartphone	
Technology Adoption	Perceived Usefulness	In my opinion, e-Wallet app is very useful	Adapted from Fernandes et al. (2014)
		In my opinion, Tax Asaan app is very useful	
		In my opinion, e-Sahulat app is very useful	
		I intend to recommend my friends to use e-Wallet, Tax Asaan, and e-Sahulat apps	
	Perceived Easy to Use	In my opinion, e-Wallet app is easy to use	
		In my opinion, Tax Asaan app is easy to use	
		In my opinion, e-Sahulat app is very easy to use	
		I have skills to use smartphone and internet	
	Perceived Trust	I trust in government to provide e-services using AI & IoT technology	
		I trust that government authorities are skilled in using technology	
		I trust that government honest in using technologies	
		I trust that government uses technology to provide services in the interest of the public	
Good Governance	Perceived Responsiveness	The government is sensitive to public opinions	Vigoda-Gadot and Yuval (2003)
		The government responds to public requests quickly	
		The government is making a sincere effort to support those residents who need help	
		The government is efficient in providing quality solutions for public needs.	
		Citizen's appeals to the government are treated properly within a reasonable period of time	
		The government has a regular reporting system on the achievements and results of the program against its objectives	
	Perceived Accountability	The government recognizes its responsibility towards the public	Said et al. (2015)
		The government follows treasury rules and regulations in all circumstances	
		The government ensures proper usage of its budget in an authorized manner	

Govts' Information Quality	Perceived Transparency	The government plan and program are implemented transparently The entire process of the government is transparently disclosed The public can clearly see the progress and situations of the government administration. The government discloses sufficient information to the public about its performance	Park and Blenkinsopp (2011)
		(I feel that) the agency's Instagram page/Facebook page/Twitter account provides sufficient contents of news & information for me to understand and get necessary facts. The agency's social media pages and accounts provide accurate information to me to understand the government & policy news correctly. The agency's social media pages and accounts provide diverse and various information to me. The agency's social media pages and accounts provide the news & information timely. The agency's Instagram page/Facebook page/Twitter account provides access to other information sources to me (e.g., links to useful government websites) The agency's Instagram page/Facebook page/Twitter account provides additional access to other information channels to me (e.g., link to agency's website, contact information) The agency's social media accounts provide appropriate information to me	Park et al. (2016)