Public Service Resilience on the Cloud: State Mobilization and Digital Self-governance in China's COVID-19 Response

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Abstract

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Keywords: digital self-governance; digital platforms; state mobilization; collaborative emergency management; COVID-19; China

Evidence for Practice

This article has several implications for practitioners. First, public sector leaders should help transform and sustain the dynamic of digital collaborations through various digital governance patterns, digital platforms, and channels in order to adapt to the uncertainty and changes in a public health crisis. Second, online community organizers who adopt a centralized management strategy are more likely to build

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trust quickly at the early stage, whereas a decentralized pattern performs better in the long run due to its sustainable self-management structure and expansion of inter-organizational collaboration networks built at digital platforms. Third, ordinary citizens' and volunteers' digital engagement in public service delivery is critical during and beyond a crisis.

Introduction

The research on collaborative and interactive governance has focused on the role of nongovernmental organizations in providing public services (Donahue and Zeckhauser 2012; Torfing et al. 2012, 2019, 2020; Sørensen and Torfing 2017). These studies highlight the importance of cross-agency collaboration and interaction between state and non-state stakeholders for the good functioning of the governance system and the management of public affairs. Furthermore, the literature on collaborative emergency management shows that the public sector, particularly during large-scale catastrophic events, tends to form effective collaboration systems with non-profit and private organizations (Comfort and Kapucu 2006; Kapucu, Arslan, and Demiroz 2010). According to recent research, new technologies such as artificial intelligence (AI) and a variety of digital tools promote public sector reforms and improve public service delivery (Lips 2019; De Blasio and Selva 2019). Government-sponsored digital platforms play an important role in public service provision during COVID-19 response (Shen, Cheng, and Yu 2022).

Nonetheless, emerging self-organized collaborations and online community-building are undervalued in public service delivery during and after a crisis. The global spread of digital and open government as a means of increasing transparency, participation, and coordination in public governance has largely contributed to the emergence of online collaborations. The existing scholarship on service provision in crisis management focuses primarily on the formation and patterns of collaborations between well-established governmental and non-governmental

organizations (Tang and Wang 2020; Kaltenbrunner and Renzl 2019; Teets 2009; Dong, Guo, and Huang 2019). Furthermore, coproduction or public-private collaboration is critical to the long-term viability of public service delivery in the post-crisis context. The concept of collaboration networks has received increased attention recently. Uster, Vashdi, and Beeri (2022) emphasize the significance of purposed-oriented networks in enhancing local service effectiveness that take into account both the complex relationship between different network members and the environment in which they operate for a collective purpose. Drawing on Provan and Milward's framework of interorganizational network effectiveness and Sørenson and Torfing's framework of democratic network governance, they find that the effectiveness of the network is influenced by the way the network leader leads and the network's structure. Many studies emphasize the significant role of private and non-profit actors in compensating for government deficiencies caused by the increased burden of public management, a lack of resources (human resources, equipment, time, and funds), and a surge in demand for public services during crisis response (Hudecheck et al. 2020; Trinchero et al. 2020). New empirical evidence also demonstrates that the spontaneity and autonomy of community mechanisms such as community-based organizations, local enterprises, and neighborhoods are critical to public service coproduction in an emergency, particularly for the most vulnerable population and marginalized groups (Cheng et al. 2020; Hudecheck et al. 2020).

However, there is still a gap in the literature on the growing role of self-organized digital collaborations to the delivery of public services during times of crisis. This article contributes to the body of knowledge on collaborative emergency management and public service delivery by providing a nuanced analysis of how newly formed online communities have achieved trust-building and collaborations via digital platforms among various individuals, voluntary groups, and organizations since the COVID-19 outbreak in China. It provides a new perspective of digital self-

governance beyond the major governance paradigms such as state-dominant public governance and private governance through bridging the technical element of digital platforms and the community mechanism of self-governance. By exploring digital self-governance, this article highlights how varied forms of self-organized digital collaborations work differently and examines how state mobilization and digital self-governance evolve and interact to provide public services in China's COVID-19 response.

In this article, public service resilience encompasses not only emergency response and post-crisis recovery (Kapucu and Hu 2016; Boin and Eeten 2013), but also the transformation and sustainability of public service management, the development of adaptive and self-organizing capabilities, and institution-building in both normal and crisis situations (Nicholls and Murdock 2011; Murdock and Barber 2017). In China's context, because of its unique institutional environment, dubbed "confined civil society", the significance of self-organized collaborations among individuals, voluntary groups, and non-governmental organizations in emergency management is often underrated (Yip 2020; Teets 2013; Tang and Wang 2020). During the COVID-19 epidemic, China has seen a rise in digital civic engagement, with self-organized online communities providing resilient public services. Although the state-dominated bureaucratic governance and its consequences have been extensively explored in China's COVID-19 response (Ang 2020; Yang 2020; Perry 2021), the role of digital self-governance in China's state-mobilized crisis response requires further study.

Using the COVID-19 pandemic as an example, this article examines how different patterns of digital self-governance form and evolve during China's initial response period, as well as how the interaction between state mobilization and self-organized digital collaborations influences public service provision in a crisis. It shows that self-organized online communities—apart from

the public and private sectors—play an important role in making collaborative efforts to fight the pandemic in a highly centralized institutional environment through a comparative case analysis of five selected online communities with data from interviews, surveys, and online observations. Furthermore, this article also captures different patterns and the evolution of digital self-governance by tracing the process of digital collaborations along China's timeline of COVID-19 response and explains why some self-organized online communities can provide resilient services in a public health crisis, particularly when both the public and private sectors were not ready to do so at the early stage of crisis response.

Background: Digital Self-governance in Pre- and Post-COVID-19 China

This research focuses on China's early COVID-19 response, from late December 2019, when the first cases were discovered in Wuhan, through April 2020, when the government lifted the Wuhan lockdown and normalized the country's epidemic prevention and management. Because of different variants and the government's Zero-Covid policy in place, China's COVID-19 response is currently ongoing. Therefore, the terms "pre-COVID-19" and "post-COVID-19" here refer to the timeframes before and after late December 2019. In China's virtual space prior to COVID-19 outbreak, there had already been a new pattern of state-society interaction that drove online collaborations and public service provision in a wide community across different localities. Given the rapid growth of digitalized information on the Internet and advances in computing and machine learning, it is becoming increasingly difficult for the regime to fully support or completely block its digital civic space, if any, for the sake of political stability and public perception of government performance.

The Chinese state appears to be taking a two-pronged approach to dealing with online self-organized communities and grassroots organizations. On the one hand, the government allows

individuals and private organizations to participate in public affairs via the cyber channel, which has lower information asymmetry and communication and cooperation costs. Marketization reforms in China have improved public service delivery and multi-level collaborative governance by coordinating fragmented policy systems and improving resource utilization quality, particularly under China's "Internet +" national strategy, which has been in place since 2015. (Jing 2015; Jing and Li 2019). For example, social media platforms such as WeChat and Weibo enable better communication and information sharing across different areas, whether rural or urban. Furthermore, the increased use of mobile phones and high Internet coverage rates across China enable efficient channels for collecting public opinions and complaints, signing petitions, and monitoring government performance, increasing government transparency and responsiveness. According to Kittilson and Dalton (2011), virtual interactions have some of the same benefits as traditional social interactions in terms of citizen norms and political involvement.

On the other hand, the Chinese government occasionally preoccupies and infiltrates the digital civic square in order to strengthen state control by purposefully recruiting mass surveillance from the public (Pan 2020) or tacitly encouraging incivility, fragmentation, and contention in the virtual civic space through a divide-and-rule strategy (Jiang and Esarey 2018). Nonetheless, prior to the COVID-19 outbreak, self-organized voluntary groups were relatively active in China's response to disasters and public crises such as the 2003 SARS outbreak and the 2008 Wenchuan earthquake (Xu 2017). Despite the fact that the state-mobilized crisis response has an ingrained centralized governance style (Huang 2004), Chinese government agencies have become acquainted with and regularly collaborated with various voluntary groups and social organizations in the post-crisis provision of needed social services (Fu 2021).

With improved governance capacity and legitimacy as a result of lessons learned from prior crisis response and disaster relief, the Chinese government may be better prepared to deal with the pandemic in the post-COVID-19 setting (Baekkeskov and Rubin 2017; Christensen and Ma 2021). In comparison to the SARS epidemic in 2003, for example, COVID-19 containment involves more use of social media and digital technologies such as cloud platforms, AI, and big data analysis. As a result, state-led emergency management is becoming more precise and efficient in China (Yang 2020). China's COVID-19 response is marked by stringent state control and repression via state mobilization, as well as the resurgence of party-led civil society (Fu 2021).

At the same time, given the enormous challenge of providing the necessary services during the emergency response, the Chinese government implicitly leaves some room for online communities and non-profit collaborations. Particularly, in the initial response period, when the government and the market were temporarily unable to fill the gap between demand and supply of public services, online self-governing communities stepped in. These self-organized online communities, characterized by spontaneity, professionalism, and flexibility, are involved in a wide range of fields, including medical and health information-sharing, medical logistics, and virtual counseling during China's COVID-19 response.

Online communities and their use of digital platforms, as a source of increased post-crisis adaptability and public service resilience, expand the existing organizational networks and facilitate cross-boundary collaborations in the delivery of needed supplies and services in COVID-19 response. During the lockdown and quarantine, for example, some online groups used WeChat and Shimo to coordinate with various individuals and organizations, shared information about urgently needed materials through their social networks, and built trust among collaborators who may have been strangers to each other prior to the COVID-19 outbreak (Wang and Cheng 2021;

Cook 2009; Black et al. 2011). During the self-organized COVID-19 response, social capital in the form of trust and reciprocal interaction fostered collective action and mobilized resources via existing as well as newly-built collaborative networks (Wu 2021).

Theoretical Framework: Digital Self-governance under State Mobilization

Three Governance Models for Public Service Provision

For public service provision, there are three main governance models: bureaucratic governance led by government agencies' centralized management of needed materials and services (Kettl 1997; Light 2006; Wise 2002; Moynihan 2006; Pollitt and Bouckaert 2011), private or polycentric governance characterized by private actors' participation in public service provision (Ostrom 1990, 2010; Provan and Kenis 2007; Isett et al. 2011; McGinnis and Ostrom 2012), collaborative or interactive governance that entails integrating bureaucratic, market, and community mechanisms into the governance of public affairs (Ansell and Gash 2008; Donahue and Zeckhauser 2012; Torfing et al. 2012; Sørensen and Torfing 2017; Torfing et al. 2019; Torfing et al. 2020). In practice, these three modes are not mutually exclusive and are frequently switched and developed to varying degrees depending on the circumstances. In a highly hierarchical institutional environment such as China's, the bureaucratic governance model is particularly dominant among the three.

The introduction of self-governance extends the collaborative governance model with more diverse governance actors and the inclusiveness of various governance mechanisms based on self-organization in resource mobilization and public service provision. Instead of a simplified and biased account of China's state-dominated efforts to provide resilient public services, this article provides a more comprehensive explanation that includes and legitimizes various governance

mechanisms in emergency management. Individuals, social groups, and private organizations can use inclusive mechanisms to influence government decision-making and improve the delivery of public services without challenging state power (Han 2016).

A broad range of participation not only increases the supply of needed resources and the flexibility of voluntary actions, but it also stimulates competition and professionalism in public service delivery. Cooperation and competition among diverse stakeholders and governance mechanisms are conducive to strengthening the state's governance capacity and legitimacy as well as the integrative efforts of the self-organized digital communities to deal with public crises.

State Mobilization in Public Crisis

The state-mobilized campaign is defined as "the state's extraordinary mobilization of people and resources to implement a specific program to accomplish particular goals in a defined period" and characterized by "extraordinary mobilization, sharp focus, compressed time scale, and sidestepping rules" (Strauss 2019, 22-25; Looney 2021, 12). State-mobilized campaigns in China can be traced back to Mao's era and were launched for a variety of reasons, including economic development, ideological guidance, class struggle, and emergency management. State-mobilized campaigns, as opposed to regular policy implementation, have a high level of activity (Bennett 1976; Cell 1977; Perry 2011) and organize citizens as well as street-level bureaucrats to act collectively for certain state goals (Ekiert, Perry, and Yan 2020).

China's state-sponsored COVID-19 campaign, also known as the "people's war against the virus", mobilized citizens and dispatched grassroots officials to neighborhoods and village communities to strictly monitor and control the pandemic (Perry 2021, 392). Self-organized online communities were formed under state mobilization to achieve efficient collaborations on emergency management in a short period of time. These non-governmental forces play an

indispensable role in post-crisis service provision, bringing together diverse stakeholders and a plurality of governance mechanisms in addition to the single bureaucratic mechanism (Zhong and Mozur 2020; Fu 2021).

State mobilization has two different effects on China's response to COVID-19. On the one hand, the state can quickly mobilize all types of resources from the entire society in a short period. The dominant bureaucratic governance mechanism and state control are frequently visible in emergency management and manifested in local public affairs governance (Hsu and Hasmath 2014). Governance failures during the first response period, on the other hand, reflect the flaws of centralized bureaucratic governance. The duality of state mobilization allows for the emergence of digital self-governance while also limiting its further flourishing.

Digital Self-governance: An Emerging Paradigm beyond States and Markets

In China's early crisis response, the combination of state mobilization and self-organized online collaborations is critical to public service provision. In this article, digital self-governance is defined as online collaborations between a variety of governance actors—states, markets, and societal actors—using various governance mechanisms such as the government-led bureaucratic mechanism, the market mechanism, and the community mechanism. Compared to the conventional methods of public service delivery, it offers more possibilities for the governance patterns initiated by various actors, including ordinary citizens, regarding decision-making and service co-production on the ends of public health and welfare, regarding a broad range of crisis management policies, such as quarantine and lockdown measures. Table 1 compares various governance paradigms for public service provision in terms of governance actors, governance mechanisms, and characteristics.

[Table 1 here]

Self-governance is an overarching concept that incorporates market and societal forces into governance mechanisms and is viewed as an extension of polycentric governance and collaborative governance. Embedded in the community mechanism, the connotation of 'self' in 'self-governance' refers to a wide array of individual and collective agents ranging from individuals, voluntary organizations, businesses, and public institutions autonomously working towards certain public goals such as efficient, effective, and democratic governance (Sørensen and Triantafillou 2009; Aligica 2018).

With both the digital and self-governing community elements, the term "digital self-governance" refers to an emerging governance paradigm that transcends the dichotomies of states or markets, public or private, and profit or non-profit. Digital self-governance, as opposed to digital government or e-government (Baker 2009) and digital governance or government-citizen interaction (Bannister and Connolly 2012), emphasizes self-organized online collaborations between various stakeholders (individuals, voluntary groups, grassroots organizations, and communities) and mechanisms (bureaucracy, market, community) via digital platforms. The importance of analysis in this article is attached to how digital self-governance fosters adaptability in crisis response through online community-building and holds the synergy or embeddedness between various types of governance actors and mechanisms (Ansell and Gash 2008; Milward and Provan 2000, 2003).

The "digital elements" in this context refer not only to the use of digital tools (like ICT), social media (like WeChat), and collaboration platforms (like GitHub), but also to the development of online communities in the vibrant civic space within China's state-centered institutional environment in order to strengthen public service resilience. Online communities may differ from traditional communities in that members have more technical resources and flexible ways to

engage in a wide range of volunteer activities for a collective purpose without being restricted by time or location. Online community-building could boost the effectiveness and efficiency of collaboration in emergency response while avoiding the expenses and inconveniences associated with registering with and interacting with government agencies.

Public service resilience in this article relates to the sustainability of both post-crisis recovery and pre-crisis preparedness against future uncertainty, such as monitoring, early warning, and disaster evaluation mechanisms (Boin and Eeten 2013). Given the ongoing COVID-19 pandemic, digital self-governance is critical to maintaining public service resilience because it involves not only the technical element of exchanging information and resources, but also another dimension of "interoperability"—operational self-governing mechanisms for different individuals, organizations, and sectors to collaborate on public service provision in a crisis (Kapucu and Hu 2016; Murdock and Barber 2017; Hudecheck et al. 2020).

Methods and Data

Using comparative case study methods, this article selects five cases of digital communities to conduct 24 key informant interviews for both cross-case and within-case analyses of distinctive patterns and the evolution of digital self-governance. This study, which is part of a research project called "Digital Self-governance in COVID-19 Response" and is based on data collected from 42 newly emerged Chinese digital communities, has two primary case selection criteria: one is an online community's lifespan of at least three to four months as the minimum average time for self-organized community-building to have an impact during China's first response period (from December 2019 to April 2020), and the other is about its activity—over 15 to 20 collected items of online events for public service provision—as the average basis for capturing reliable evidence of digital collaborations. The interviewees are chosen from among the five online communities'

initiators and key contributors because they either initiated the formation of online communities or participated in the entire process of community-building and digital collaborations. Volunteers in those online communities come from all walks of life, with roughly 10% from government agencies, 65% from nonprofit organizations, and 25% from businesses.

Despite the fact that the five cases are all about self-organized collaborations in a virtual space, they differ in terms of core services, member backgrounds, and main collaboration platforms (see Table 2). For cross-case analysis, this article chooses NR and Wuhan 2020 for a more in-depth comparison because they both have members with relevant professional experience and use relatively diverse digital platforms but exhibit two distinct patterns of digital self-governance. When these two models are compared, it provides a more nuanced picture of how different community features and collaboration patterns shape their different performances. For within-case analysis, this article presents a stand-alone investigation of Wuhan 2020 and A2N to capture the evolution process of digital self-governance, as they have become the two largest and most sustainable communities after merging with the others for organizational integration.

[Table 2 here]

In addition to the first-step interviews, this study conducts online surveys among randomly selected community members as a supplement to the data from the interviews to strengthen its internal validity. This article employs a total of 125 valid survey observations, with an average of 25 valid observations from each of the five cases. All of the interviews and surveys were mostly conducted between June and August of 2020. Using Nvivo 12 for data organization and analysis, the study shows that the evidence from online surveys is consistent with that from interview transcripts. Some of the key questions from the semi-structured interview guide are similar to those put in online surveys. For example, when, how, and why did you become a member of the group?

How did you organize the community, and what digital platforms did you use? Was there any unambiguous leadership? Was there a shift in the way your community collaborated? If this is the case, how does it affect your assessment of the community's performance? Did your community benefit from any inter-organizational collaborations? If so, with which organizations did you work? [i]

According to the interviews, the author summarized seven evaluation dimensions that are most relevant to revealing the attributes of online communities and explaining variations in their performance in collaborative crisis response. To better capture the features of distinct digital self-governance patterns, survey respondents were asked to rate each online community on a 0-1 (or 0%-100% by using the min-max scaling) scale along the seven dimensions: leadership (central node), organization structure (decentralization), collaboration platforms (platform diversity), service channels, inter-organizational collaboration, organizational evolution, and performance (responsiveness, social impact, self-management).

Furthermore, from December 2019 to April 2020, this study employs process tracing to capture the dynamic process of online community formation and evolution using the qualitative data evidence from interviews and observational data at digital platforms. Given the global and Chinese COVID-19 response timelines (WHO 2021; Xinhua 2020), this article chronicles China's early response in a nuanced approach to demonstrate how state mobilization and digital self-governance intertwine in China's COVID-19 containment. Although the government mobilized a flood of donations and needed resources, its capacity to manage donations and medical supplies was inadequate at the outset, when the government-dominated donation system excluded non-governmental organizations and social groups from the delivery of needed supplies and services. On January 23, 2020, Wuhan, the original place where the epidemic was identified, was locked

down by the central government but the local public service system was unprepared, resulting in a surge of criticism of the government failure on the Chinese social media platform—Weibo (Lu, Pan, and Xu 2021). Many online communities sprang up immediately after the Wuhan lockdown as a response to the massive demand for public services. Because of the concerns expressed by the online public, the relevant government agencies responded by reducing government control over the distribution of critical supplies and services (HRCS 2020; RCSC 2020). It is uncommon in history and demonstrates how rising public pressure from the digital society forces the government to improve its crisis management responsiveness and inclusivity.

Results

Distinctive Patterns of Digital Self-governance: A Cross-case Analysis of Centralized vs. Decentralized Collaborations

Although sharing a similarity of collaborating on the virtual space for emergency response, those self-organized collaborations differ in many ways. For example, NR (Novel Coronavirus Pneumonia Relief) provides online medical consultation and psychological assistance based on its volunteers' past professional experience in crisis management, medical treatment, and training background as social workers; Wuhan 2020 provides technological support for sharing information about hospitals, restaurants, schools and shops by creating data warehouses and building an open-source online community; MP and Simo editorial teams recruits volunteers who had worked in the publishing industry and formulated guidelines for information collection and publication at a very early stage of COVID-19 response; Bridge is started by a group of programmers to share structured information of designated hospitals and available beds for COVID-19 treatment by making full use of Shimo, a Chinese cloud-based office system; A2N (Anti-2019-Novel Coronavirus Pneumonia), with volunteers from all over China organized at WeChat groups, focuses on

promoting science popularization, refuting rumors and translating global work of COVID-19 prevention and control.

Using a cross-case analysis, this section shows how the centralized (NR) and decentralized (Wuhan 2020) patterns of digital self-governance differ and complement each other along seven dimensions (see Table 3-4). Table 3 is a descriptive table based on data from 24 key informant interviews, whereas Table 4 shows average ratings from 125 survey respondents' multi-dimensional evaluations. Even within the same category of digital self-governance, the two sets of consistent data show that there are significant disparities between the two online collaboration patterns.

[Table 3-4 here]

The NR model is a centralized design of digital self-governance based on clear leadership and built on social networks and emergency management experience. This pattern tends to be efficient with enough trust among the community with a clear central node in collaboration networks at first, but its evolution and performance are limited by the single leadership and hierarchical management (see Figure 1). Wuhan 2020 model, on the other hand, is decentralized and spontaneously established by loose-knit groups of volunteers who were primarily strangers before the COVID-19 outbreak. Without a central node, this pattern encourages more flexible interaction and trust-building among contributors, as well as democratic decision-making, expansive resource networks, and organizational growth (see Figure 2).

[Figure 1-2 here]

Based on a digital network of doctors and social workers in pandemic response, NR was noted for its specialized services such as medical consultation and psychological assistance as well as work efficiency at the early stage. Within a week, NR had created its organizational structure and

workflow under the guidance of a few initiators. The central leadership is crucial to its self-organized management, resource allocation, and work arrangement. Due to their similar professional backgrounds and disaster relief collaboration experience, the founding members get along swimmingly thanks to a strong trust connection and low communication costs at first. However, NR's organizational evolution and performance were hampered later by its centralized management structure and internal disputes over management style between the initiators and new members. On June 14, 2020, the author conducted an interview with Mr. Tao, the founder of NR. To maintain confidentiality, pseudonyms for individuals and organizations are utilized.

> I'm a senior participant and organizer of non-profit disaster relief information service provision. In 2010, I founded the Guo Ming Disaster Information Service Center (GM) in China. GM specializes in processing disaster information, helping resource mobilization, and enhancing disaster relief efficiency, with members who worked during the 2008 Wenchuan earthquake and other public crises. In the past decade, GM has responded to over 100 natural disasters. As a former medical practitioner, I also have a solid network of medical staff and social workers. I promptly formed NR with my charity partners and core members in GM after hearing about the epidemic in Wuhan on January 22, 2020, based on our team's professional understanding and rich disaster relief experience. We all knew something had to be done, but none of us could do it alone. Throughout NR's different stages of growth, consensus became the driving factor. "Responsibility, commitment, collaboration, and empathy" are the same standards for our volunteers, and our tagline "Lives Save Lives" embodies the group's identity. We have an initial trust among our networks because the founding members had cooperative experience prior to the COVID-19 outbreak. However, I must acknowledge that we suffered a lot from the disputes with the new members who joined us later.

Wuhan 2020, by contrast, is more decentralized, involving more community negotiations in decision-making and organizational management. Wuhan 2020 was founded by a group of volunteers who shared the vision of an open-source community but did not know each other before to the event. Members of the community use GitHub, Slack, Shimo, and even collaborative robots with emotional intelligence for frequent engagement and cooperation, drawing on their technical

knowledge as data scientists. As a result of the constant trust-building and self-enforcing interactions, resource networks and inter-organizational collaborations are expanded through the sharing of information and technical services across multiple platforms, further strengthening their capacity to run a permanent organization and share digital solutions with a broader network of individuals.

The Evolution of Digital Self-governance: A Within-case Analysis of Distributive Network-based Collaborations

This article conducts a within-case analysis of Wuhan 2020 and A2N respectively in addition to the cross-case analysis to capture the evolution of digital self-governance and its interaction with state mobilization during crisis response. Figures 1-3, adapted from Luther and Smith (2020), show three distinct patterns of digital self-governance at different times. During China's first response period, those online communities went through four stages: formation (January 23-February 9, 2020), development (February 10-February 23, 2020), evolution (February 24-late March 2020), and normalization (late March-late April 2020). Figure 3 depicts the evolution of digital self-governance towards a distributive pattern in which inter-organizational collaborations become normalized and institutionalized based on the shared norms and commitments.

[Figure 3 here]

The evolution of those online communities demonstrates the continuity and adaptability of digital self-governance in order to avoid information and functional redundancies through cross-organizational collaborations and integration (see Figure 4). Wuhan 2020 and A2N have gradually become the two largest existing online communities after merging with some others within each case since the evolution stage. In terms of information collection and dissemination, some core services of MP and Bridge had been transferred and merged into Wuhan 2020 and A2N by the end

of March 2020, when NR had been fully developed through sharing information on needed services such as self-care guidelines but was unable to continue the evolution due to self-limitation and insufficient inter-organizational collaborations. Finally, after the final stage of "normalization", MP, Bridge, and NR competed their missions and gradually ceased operations, while Wuhan 2020 and A2N were institutionalized as formally registered emergency management organizations. As an information and technical center in the digital collaboration network, Wuhan 2020 continues to provide technical support to other online communities and organizations. A2N has become the best example of how volunteers from various backgrounds can provide cross-field services and promote science popularization.

[Figure 4 here]

Finally, China's timeline for responding to COVID-19 shows a parallel between the evolution of self-organized digital collaborations and dynamically adjusted state mobilization strategies. For example, most online communities arose immediately following the Wuhan lockdown on January 23, 2020, as a result of local government failure, and evolved in line with the state's changing mobilization strategies of "tightening-loosening-tightening" at their respective stages of "formation-development-evolution" in China's COVID-19 response (CMCA 2020; Xinhua 2020). It also reveals the interaction and synergy between different governance paradigms for public service provision in a public crisis, such as state-dominate governance and digital self-governance.

Discussion

Although state mobilization is effective at gathering needed resources in a short period of time, it may fail to meet the needs of public service provision in emergency management by relying solely on the state-dominated governance system, stimulating demand for a diverse array of governance mechanisms. Individuals, voluntary groups, grassroots organizations, and online communities, in

particular, are facilitating the emergence and evolution of digital self-governance mechanisms through various digital technologies and collaboration platforms.

The combination and interaction between state mobilization and digital self-governance tell a more complete story of China's fight against the COVID-19 pandemic and public service provision through the collaborative efforts of various stakeholders. The state allows for some leeway in digital self-governance at the start of the crisis response, and the formation, development, and evolution of those online communities, in turn, strengthen the legitimacy of top-down stringent measures like wearing masks, maintaining social distance, and implementing lockdowns. Given that the pandemic is still ongoing, with different variants posing challenges, the repeated cycles of interactions between state mobilization and digital self-governance are likely to persist in current and future pandemic responses in various countries.

Furthermore, there may be some new phenomena and causal links at work that will shape the outcomes of the COVID-19 response. As a result, it is necessary to make ongoing efforts to conduct high-quality research on a timely basis, as well as to keep a close eye on this front. However, due to space constraints, this article cannot address all of the aforementioned issues or delve into more findings from the entire research project by only presenting data evidence from late December 2019 to late April 2020.

Despite its global implications, this study does not intend to advocate for state mobilization in broader society. Instead, it emphasizes that the resilience and adaptability of public service provision are critical to emergency management, particularly during the first response period, when there are usually some governance failures in different localities, but are not impossible to achieve with online community-building and collaborations through various digital self-organization channels in a relatively flexible manner. Even under China's centralized campaign-

style governance, digital self-governance works, and thus the lessons learned in China should be applicable to other contexts and integrated into the global knowledge base of collaborative emergency management.

What Can Practitioners Do to Better Use Digital Self-governance in COVID-19 Response?

Trusting and Promoting Online Community-building and Digital Collaborations in Uncertainty

For social stability and political support, most public sector leaders prefer to take conservative measures to deal with uncertainties in a public crisis. Given that the COVID-19 pandemic is far from over, it provides a timely and important reminder for government officials to continue learning by doing in the face of uncertainty. Without institutional changes and innovation in governance channels, the government's purely campaign-style governance is doomed to fail due to a lack of capacity to sustain the costly stringent measures. Allowing individuals to participate in emergency management, on the other hand, will increase the flexibility and adaptability of public service delivery through the use of digital platforms. This article provides credible evidence for public sector employees to trust and promote self-organized digital collaborations in order to adapt to changing conditions in a public health crisis.

Strategically Facilitating Different Patterns of Digital Self-governance at Different Stages of COVID-19 Response

The cases of distinct digital collaboration patterns presented in this article have implications for all practitioners in the public, private, and non-profit sectors, implying that emergency management strategies should be adjusted at various stages of crisis response. As new information

and members arrive, the governance mechanisms and foundations for collaborations may change at different stages of community development. A centralized management strategy may be beneficial in the early stage of building trust, whereas a decentralized pattern tends to last longer and perform better in the long run due to its sustainable self-management structure and expansion of inter-organizational collaboration networks. Finally, community members should be encouraged to develop shared norms, make commitments, and formally register self-organized online communities in order to achieve a sustainable distributive pattern of digital self-governance and build a resilient collaborative emergency management system.

Encouraging Digital Civic Engagement during and beyond the Pandemic Response

China has a long history of state mobilization in public health crises, such as the 1952 Patriotic Health Campaigns, the 2003 SARS epidemic, and the ongoing COVID-19 pandemic, resulting in state-dominated path dependence and intellectual laziness in emergency management. Individual citizens' or netizens' digital engagement in public service provision, as an important supplement to state efforts, benefits the emergence and growth of digital civil society during and after the pandemic response by integrating different stakeholders' efforts into collaborative emergency management.

Conclusion

When public sector leaders are accustomed to state control and governance failures in crisis response, new governance paradigms and service channels should be discussed empirically and theoretically. Using comparative case analysis, this article investigates the distinguishing characteristics and evolution process of various digital self-governance patterns, as well as their implications for collaborative emergency management and public service provision. Based on

qualitative data from interviews, surveys, and online observations, this article elucidates the dual effects of state mobilization in crisis response as well as the dynamic state-society interactions at various stages of digital collaboration and online community-building in a public crisis.

The findings have implications for practitioners in that the centralized pattern (NR) builds trust more efficiently early on with the help of core opinion leaders, existing social networks, and shared work experience, whereas the decentralized pattern (Wuhan 2020) performs better in the long run in expanding inter-organizational collaboration networks based on expansive interactions and diverse service channels. This article discovers, through a chronicle analysis of the integration of various communities, that the distributive pattern of digital collaborations (A2N) formulates institutionalized networks based on shared norms and provides resilient services in a sustainable manner, which has significant global implications for pre-crisis preparedness and post-crisis institution-building. Finally, the merging and extension of some core services between different online communities stems from and advances inter-organizational collaborations, which promotes the integration of various stakeholders' efforts and strengthens their adaptive capabilities to provide public services in uncertain times.

In terms of theoretical implications, this article adds to the discussion of an emerging governance paradigm—digital self-governance—that differs from existing governance models and involves multiple governance mechanisms to achieve specific goals in crisis response. The resilience and adaptability of digital self-governance stem from a diverse set of stakeholders with varying expertise and professional backgrounds, ensuring both vertical and horizontal collaborations with government agencies and other equivalent self-organized communities. It also paves the way for future interdisciplinary research on the coexistence and interaction of various

governance paradigms in order to build a global knowledge base of collaborative emergency management.

Notes

1. This study has been officially approved by the University of Pittsburgh's Institutional Review Board (IRB) with the approval number "STUDY21050184" and meets all of the requirements for research involving human subjects. The IRB approval letter, complete interview guide, and survey questionnaire are all available upon request. For purposes of transparency, the interview data is completely anonymized and stored in the cloud under the supervision of the institution. All of the quotations in this article have been verified with multiple sources.

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Appendices:

Table 1 A Comparison of Governance Paradigms for Public Service Provision

	State-dominant bureaucratic governance	**Private governance**	**Self-governance**	**Digital self-governance**
Governance Actors	the public sector, government agencies, government-affiliated institutions	the private sector, enterprises, non-governmental organizations	individuals, social groups, voluntary groups from public, private, and non-profit sectors	individuals, voluntary groups, grassroots organizations, online communities
Governance Mechanisms	bureaucratic mechanisms	market mechanisms	community mechanisms	a plurality of mechanisms
Highlights	state control, powerful mobilization, government failure	efficiency, profit-driven, competition, market failure	spontaneity, self-organization, polycentricity, coordination	flexibility, technical element, online community-building, collaboration networks

Table 2 A Summary of the Five Cases

Cases	Core Services	Community Members	Main Collaboration Platforms
NR	online medical consultation, psychological assistance	volunteers with professional experience in emergency management, medical treatment, and social work	WeChat, Shimo (a cloud-based office system)
Wuhan 2020	technological assistance, sharing information about available facilities, constructing data warehouses, and establishing an open-source online community	ICT practitioners, computer scientists, data scientists	GitHub, Slack
A2N	promoting science popularization, translating and reporting on global	volunteers with various backgrounds	WeChat

	COVID-19 response work		
MP	information gathering and dissemination	an editorial team with publishing industry experience	Shimo
Bridge	sharing structured information about available hospital beds	programmers	Shimo

Table 3 A Comparison of NR vs. Wuhan 2020 (Interviews)

	NR Model	**Wuhan 2020 Model**
Initiators	one opinion leader	a loose-knit group of volunteers
Organization Structure	centralized mode with professional staff and social networks in disaster relief	decentralized mode with ICT practitioners, computer scientists, data scientists in an open-source community
Collaboration Platforms	WeChat, Shimo, Weibo	GitHub, Slack, Gitee (a Chinese GitHub alternative), Shimo, WeChat
Service Channels	medical consultation, counseling, information gathering and dissemination, donation collection and distribution	information gathering, processing, and dissemination (via GitHub, API server, open data warehouse, COVID-19 real-time information navigation),

		extended services: technical support (e.g. React Native APP, WebApp, website building, coding, data visualization and analysis), offline projects, innovation incubators, digital collaborative robots "Hypertrons"
Inter-organizational Collaboration	Phoenix New Media, neighborhoods in Wuhan, other grassroots organizations	information: Button Capital (medical information collection and publication), Oxford and Cambridge Alumni Assistance Associations, Simo (NGO for COVID-19 information collection); technology: Shimo, Slack, Figma (online design and collaborative platform), Gitee; production: Emotibot (a company producing emotion robots for counseling with big data and AI)
Organizational Evolution	limited evolution, internal disputes, disbanded once COVID-19 was well controlled	establishing a permanent organization with a clear division of labor,

	strengthened and extended potential networks for future collaboration	providing information and technology support to other self-organizations ("Wuhan Support"), sharing digital resolutions to COVID-19 ("Hack for Wuhan")
Performance	responsive at early stage, efficient and professional disaster relief work methods, sometimes chaotic management, a lack of a strong commitment	a clear vision "Open Source for Good", organized workflow based on consensus and protocols, a breakthrough in digital emergency response and digital volunteerism, broad public influence and media support from GitHub Trending Top, media communication on Facebook, Twitter, LinkedIn, Twitter, Instagram, Toutiao, Bilibili, WeChat, Weibo

Table 4 Centralized vs. Decentralized Digital Collaborations (Surveys)

	NR Model	**Wuhan 2020 Model**
Central Node	1	0
Decentralization	0.23	0.86
Platform Diversity	0.31	0.69
Service Channels	0.58	0.79
Interorganizational	0.43	0.89

Collaboration		
Organizational Evolution	0.32	0.84
Performance-Responsiveness	0.81	0.79
Performance-Social Impact	0.56	0.87
Performance-Self-management	0.32	0.89
Overall Solution Consistency	0.86	0.89

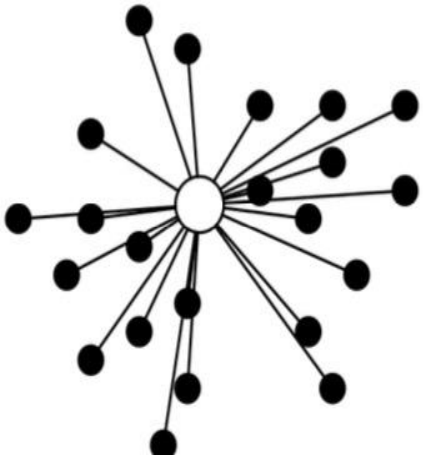


Figure 1 Centralized Digital Self-governance

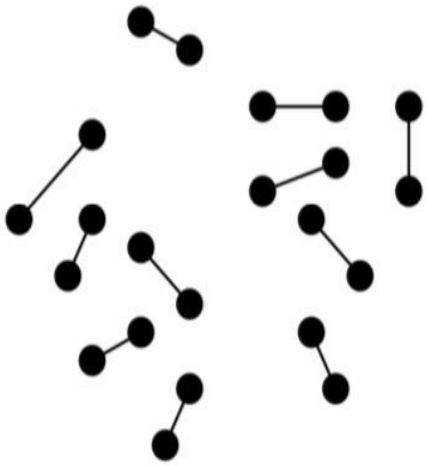


Figure 2 Decentralized Digital Self-governance

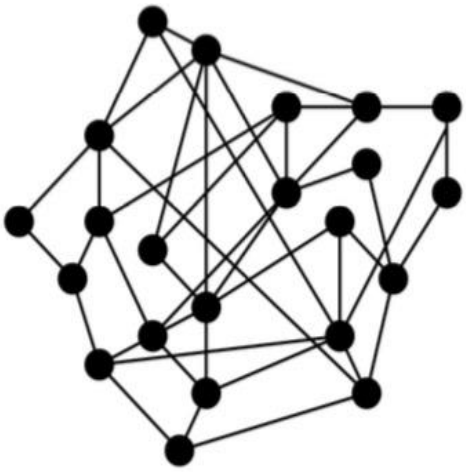


Figure 3 Distributive Digital Self-governance

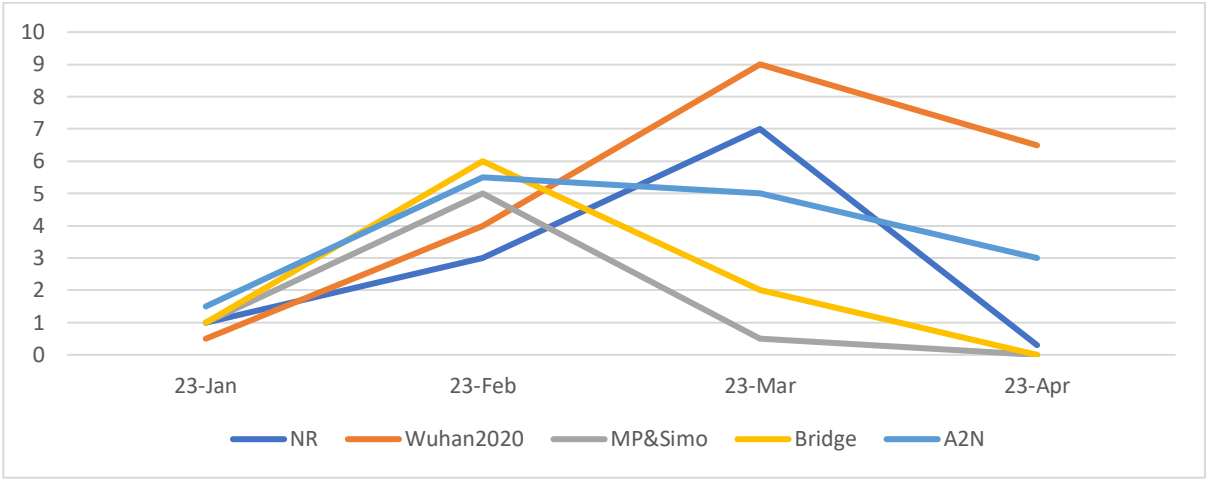


Figure 4 Different Stages of Digital Self-governance

Note: The figure is drawn by the author. The vertical axis represents the intensity of online collaborative activities, while the horizontal axis represents different times and stages of digital self-governance in 2020. Data on the intensity of activity is collected through interviews and publicly accessible content on digital platforms such as GitHub: https://github.com/wuhan2020/wuhan2020.github.io/graphs/contributors.