

**Disaster Preparedness and Complex Adaptive Systems: a Government
Continuity Plan for a Self-Organizing Community**

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Abstract

The goal of this paper is to examine how government continuity planning contributes to strengthening the public sector's disaster preparedness, resulting in enhanced resilience of the public sector. The paper analyzes basic principles of government continuity planning using Complex Adaptive Systems (CAS) theory while summarizing recent developments in theory and practice of government continuity planning. Government continuity plans (GCPs) are a recently focused concept in disaster preparedness, compared to business continuity plans (BCPs) in the private sector. Both GCPs and BCPs are designed to prepare governments and businesses for future disasters. The need for BCPs was widely recognized after the Great East Japan Earthquake (GEJE) and Tsunami in 2011, the Floods in Thailand in 2011, and Hurricane Sandy in New York in 2012. However, recent disasters in Japan, such as the Kumamoto Earthquake in 2016, have revealed that local governments without effective GCPs were severely affected by disasters, preventing them from quickly responding to or recovering from disasters. When the GEJE occurred in 2011, only 11% of municipal governments in Japan had GCPs. In developing and emerging nations, the proportion of local governments that have already formulated GCPs is minimal. Considering the vulnerabilities to disasters, the need to design and formulate GCPs in developing and emerging nations is urgent. This research investigates the Japanese experience of GCPs, using self-organization, one of the concepts of CAS. The study concludes that GCPs contribute to increased resilience among the public sector in terms of robustness, redundancy, resourcefulness, and rapidity.

1. Introduction

Resilience¹ is discussed in every corner of society, including among communities, firms, individuals, and sectors. Haraguchi, Lall, and Watanabe (2016) show that societal resilience can be enhanced through different actors' resilience. More recently, private sector and community resilience has gained attention (Kato & Charoenrat, 2017; Shaw, 2014). However, compared to private sector resilience, public sector resilience, especially the local government's, has received less attention (Kusumasari, Alam, & Siddiqui, 2010). Central governments take the lead in emergency rescue and formulate a strategy of recovery during mega-disasters. Municipal governments play a central role in emergency response and recovery by rescuing people, providing evacuation shelters, and providing emergency goods to victims, among other activities. Municipal governments also need to coordinate with national governments, donors, lifeline service providers, private companies, and community organizations to facilitate operations. The continuity of lifeline services, such as electricity, gas, heat, and water, is also critical for rapid response and recovery in communities. If governments and public lifeline service providers cannot continue to operate, the recovery and response of communities are delayed. For example, during the Great East Japan Earthquake (GEJE), known as the Fukushima or Tohoku earthquake, many municipal governments were damaged by the disaster, causing a significant delay in emergency response and recovery.

Disaster risk management includes four phases: mitigation, preparedness, recovery, and response. Specifically, the Priority 4 of the Sendai Framework at national and local levels stipulates “[e]nhancing disaster preparedness for effective response and to Build Back Better in recovery, rehabilitation, and reconstruction.” Historically, disaster risk management in governments and the public sector tend to discuss the protection of citizens from disasters, focusing on *what* governments should do during emergency response and recovery. Yet it often lacks a perspective of *how* governments can prepare for emergency response and recovery. In terms of preparedness, whereas the private sector has strengthened preparedness by formulating business continuity plans, governments and the public sector often do not have continuity plans. For example, in Japan, right after the GEJE in 2011, it turned

¹ In this paper, resilience is defined as “the ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions” (UNISDR, 2009). Resilience in this paper is understood as Social-Ecological Resilience, whose fundamental concepts are capacities for adaptability, transformability, self-organization, and learning (Davidson et al., 2016; Folke et al., 2010). This paper is also based on quantitative measures of resilience proposed by Bruneau (2003), which are robustness, redundancy, resourcefulness, and rapidity.

out that only about 10 % of municipal governments had continuity plans (Ministry of Internal Affairs and Communications, 2012). Japan Society of Civil Engineers (2012) concludes that one of the four main challenges were dealing with damages to municipal governments, which caused delays in response and recovery. They emphasize the importance of operational continuity plans.

2. Literature Review

Self-organization of Complex Adaptive Systems

Literature in emergency management has recognized that the dynamic, complex environment during emergencies requires a different approach than the conventional hierarchical command and control system, which assumes stable operating conditions during a crisis (Comfort, 1994, 2007). This has led to several scholars reframing the practice of intergovernmental emergency management as a complex, adaptive system, where one component is self-organization (Comfort, 2007; Comfort et al., 2010). Self-organization, as a concept, represents the spontaneous emergence of order in natural and physical systems (Kauffman, 1993). It is just a process of self-organization that has been observed in networks of community organization after disasters (Comfort, 1994). Comfort (1994) goes on to define a capacity for self-organization as “the ability to rearrange and reform [organizations’] patterns of operation in mutual adaptation to changing needs and capacities of their components as well as changing demands and opportunities from the environment.”

Increasingly, scholars are recognizing that communities formed as a self-organizing system are most likely to recover from emergencies (Harrald, 2006; Johnson & Olshansky, 2017). That is, one definition of resilience might be the degree to which a complex system is capable of self-organizing and the degree to which the system can build capacity for learning and adaptation (Adger et al., 2005; Johnson & Olshansky, 2017). In a practical way, resilience can be determined by a combination of degree of vulnerability and the speed of recovery and reconstruction (Haraguchi, 2019).

There are four components and characteristics of self-organization in case of disaster operations (Comfort, 1994).

1. Self-organization as a continuous process through communicative acts, which are often transmitted directly among actors within the system or between the system and the environment (Comfort, 1994).
2. Self-organization as generating the system's adaptive capacity (Comfort, 1994; Kauffman, 1993).
3. Self-organization as the influence that some units exercise over other units in an interdependent system.
4. Self-organizing systems as parallel-processing systems (Kauffman, 1993), with each component performing their own functions simultaneously to achieve the goal of the system (Comfort, 1994).

Objective of the study

Using the theory of Complex Adaptive Systems (CAS), particularly self-organization, the goal of this paper is 1) to explore how to improve government preparedness and 2) to examine how government continuity planning contributes to strengthening the preparedness and resilience of the public sector. The paper also reviews recent developments in GCPs for mega-disasters, especially in Japan. Cases in Japanese cities are selected because the Japanese municipal system falls into one of the recovery management categories proposed by Johnson & Olshansky (2017), i.e. "partly decentralized," which means that organizations at various levels of government lead response and recovery under tight coordination with a national government. This partly decentralized category is of most interest in contrast to the other two categories—centralized, such as in China and New Zealand, and decentralized, such as in India, Indonesia, and the United States—because of the complexity of coordination among the different actors, from the municipal to the federal levels. This research will address the following three research questions:

- What sorts of continuity in government operations are required for rapid response and recovery?
- How can government continuity be improved using the Complex Adaptive Systems perspective?
- How can government continuity contribute to the increase of resilience of the public sector?

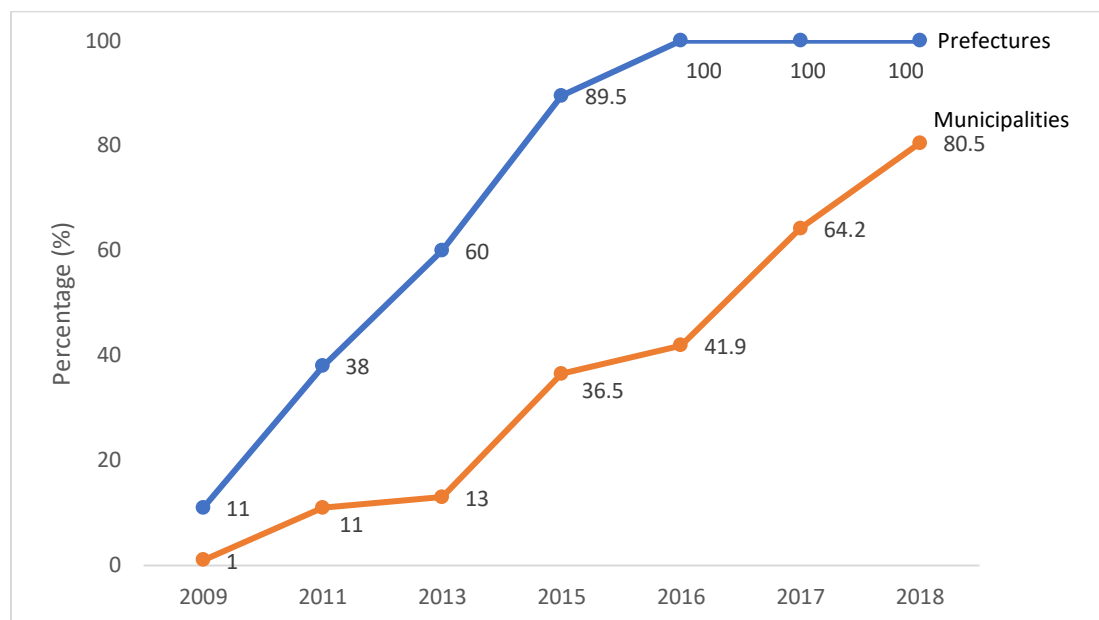
Historical discussions of a GCP

Historically, the continuation of the operation of a government or the public sector has been discussed in the context of national security, especially during the Cold War. Most countries in both the West and East made plans to continue operations even if attacked by adversaries. In the United States, Executive Order 12656 in 1988 assigned the responsibilities for emergency preparedness to the federal government. One of the targeted emergencies of the order was catastrophic disasters that threaten national security. Presidential Decision Directive (PDD) 67 was subsequently

issued in 1998 to ensure constitutional government, continuity of operations planning, and continuity of government operations; this directive focused on ensuring the “survival of a constitutional form of government and the continuity of essential Federal functions.” After the 9/11 attacks in the US, the continuity of operations plan was put into effect for the first time. In 2004, Federal Preparedness Circular (FPC) 65, issued by the Federal Emergency Management Agency (FEMA), requested the executive branch and federal governments to formulate continuity of operations (COOP) plans to ensure departments’ and agencies’ essential functions during any emergency that may disrupt normal operations. For state and local governments, Comprehensive Preparedness Guidance 101 (CPG 101) and Continuity Guidance Circular 1 (CGC-1) were developed.

During the GEJE in Japan in 2011, many governments were forced to reduce their capacity to operate due to damages to governments and the public sector. After the GEJE, the national government of Japan, under the initiative of the Cabinet Office, largely updated a GCP guideline and made efforts to disseminate GCPs to municipal governments. All the prefectures completed formulating a GCP in 2016 (Figure 1). However, a recent survey shows about 20% of municipal governments (i.e., cities, towns, and village) still do not have a GCP although the prevalence rate has increased every year (Figure 1).

Figure 1: The percentage of the number of prefectural and municipal governments (i.e., cities, towns and villages) that have formulated a GCP.



Note: In 2016, all the prefectures completed the formulation of a GCP. The ratio of local governments which has formulated a GCP is increasing over time after the GEJE. Notice that the total number of prefectures is 47 and that the total numbers of local governments in each year are 1,795 in 2009; 1,737 in 2011; 1,742 in 2013; and 1,741 in 2015–2018.

Source: Cabinet Office of the Government of Japan (2017b); Fire and Disaster Management Agency of the Government of Japan (2016, 2017, 2018)

5. Need for a GCP for Rapid Response and Recovery

Examples of damages to governments during recent disasters

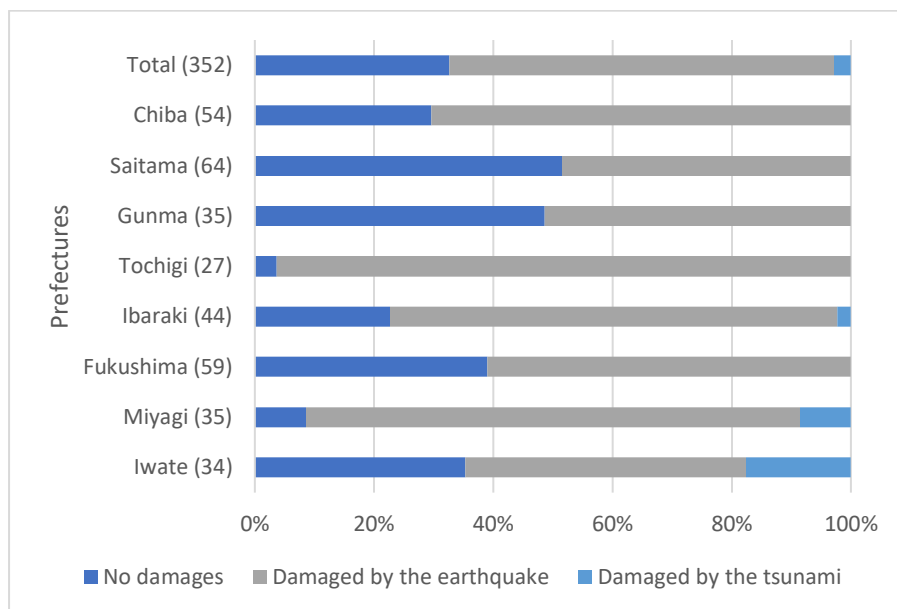
Recent disasters have revealed that it takes a community time to respond to and recover from disasters when governments are impacted by disasters. This is particularly true during mega-disasters with low-probability-but-high-consequence. Examples include the following:

- During the GEJE, 237 out of 352 municipalities in eight prefectures experienced damaged facilities (IRIDeS Tohoku University, 2018) (Figure 2). Two of the three most affected prefectures, Miyagi and Iwate, suffered from damage to 92% and 65%, respectively, of municipal governments by either the earthquake or

tsunami (IRIDeS Tohoku University, 2018). In total, 67% of municipal governments that endured more than 6 degrees of shakes had their facilities damaged by the earthquake and tsunami (IRIDeS Tohoku University, 2018), and 16 local governments had to relocate their municipal functions to other facilities (The World Bank, 2014).

- During the GEJE, 221 municipal officers were killed or missing in 17 municipalities in the three most affected prefectures. In the town of Otsuchi, the mayor, 6 managers, and 33 of 139 city hall staff were killed (Iwate Prefecture, 2013). In Rikuzentakata, 111 city staffs were killed by the tsunami (Rikuzentakata City, 2014). In Minamisanriku, 39 out of 240 staffs were killed (The World Bank, 2014). Such losses of human resources caused a delay in emergency response and recovery (Japan Society of Civil Engineers, 2012).
- During the Kumamoto earthquake in April 2016, the city hall for five municipalities in Kumamoto prefecture (i.e., Yatsushiro City, Hitoyoshi City, Uto City, Ozu Town, and Mashiki Town) was so severely damaged that city officials could not use it for recovery and response efforts (Saito, 2016). Among them, Yatsushiro City, Uto City, and Mashiki Town had not formulated a GCP as of December 2015 (Fire and Disaster Management Agency of the Government of Japan, 2015). It took three days for Uto City to find an alternative facility for the city hall functions (Saito, 2016).

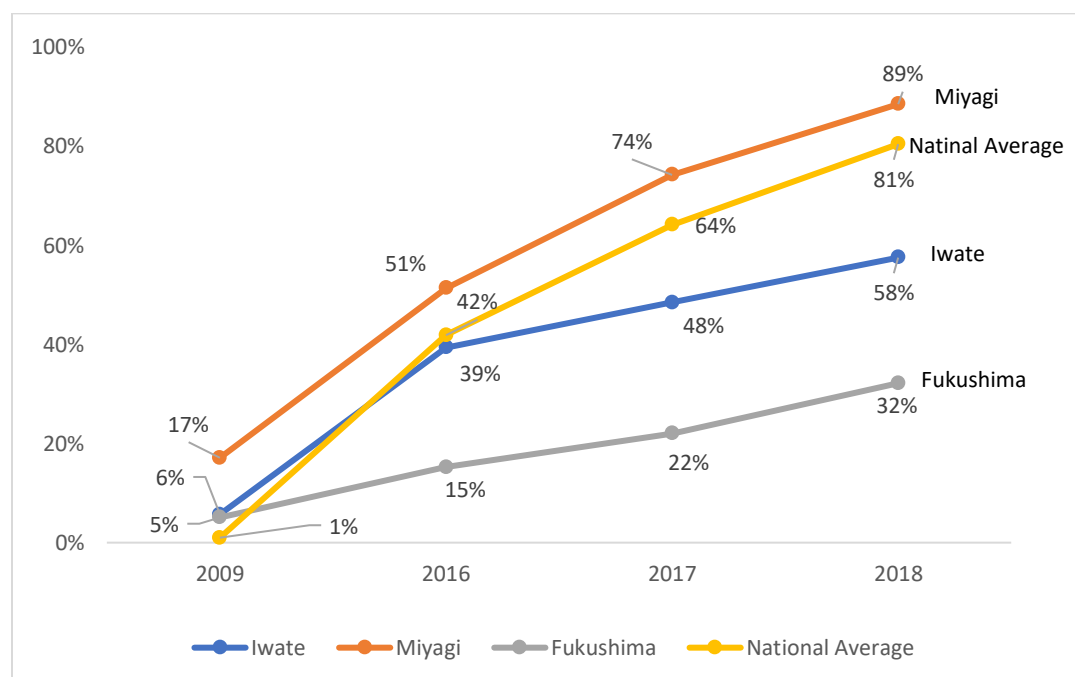
Figure 2: Municipal governments damaged by the Great East Japan Earthquake and Tsunami in Japan in 2011.



Note: Numbers in parentheses indicate the number of municipalities that had more than 6 degrees of shakes. Source: IRIDeS Tohoku University (2018).

Before the GEJE, many municipal governments did not have a GCP. In 2009, 11% of the prefectures and only 1% of local governments (i.e., cities, towns, and villages) in the national average had a GCP. Specifically, the numbers in Tohoku region were higher compared to the national average, but only 6% in Iwate, 17% in Miyagi, and 5% in Fukushima prefectures had a GCP (Figure 3). With the current data, it is not feasible to assess the actual impacts of a GCP on the speed of response and recovery during the GEJE; however, there is a possibility that the low prevalence rate of a GCP might affect the speed.

Figure 3: Percentage of the number of municipal governments that has a GCP in Iwate Prefecture, Miyagi Prefecture, Fukushima Prefecture, and the national average in 2009 and 2016–2018.



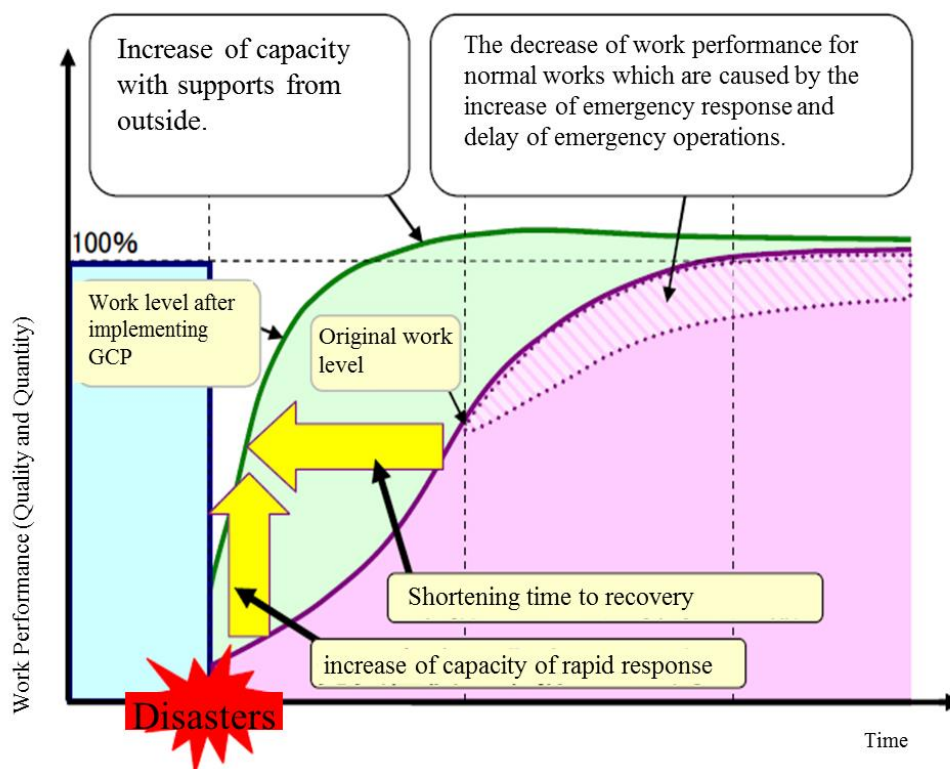
Note: The total number of local governments are 35 in 2009 for Iwate, 33 in 2016–2018 for Iwate, 35 for Miyagi, and 59 for Fukushima. Notice that the data in 2009 represents the percentage of governments that prepared for continuity operations, not the percentage of governments that formulated a GCP. Source: The Cabinet Office of the Government of Japan (2010); Fire and Disaster Management Agency of the Government of Japan (2016, 2017, 2018).

The effectiveness of a GCP

GCPs can help local governments recover rapidly from disasters. Theoretically, a GCP will help local governments in four areas (The Cabinet Office of the Government of Japan, 2015). First, governments can shorten the time to recovery (Figure 4). Second, governments can increase their capacity for rapid responses with a GCP (Figure 4). GCPs enable local governments to prepare for rapid response by prioritizing essential functions and works during emergencies. Third, governments can increase the capacity to receive outside support from a national government, other local governments, NGOs, and donors. Such increased capacity enhances the overall capacity of local governments' work performance and sometimes exceeds the pre-disaster work performance due to outside supports.

The fourth benefit of making a GCP and sharing it in public is that various stakeholders, such as politicians, other governments, NGOs, and donors, are familiar with the roles and critical functions of a public servant in an affected government (Clark & Wilairat, 2009). A publicly available GCP helps outside organizations conduct emergency response and recovery activities smoothly since outside organizations can refer to a GCP that contains information about available (and lacking) resources and preparedness in order to get the picture of areas to be assisted.

Figure 4: Image of the effect of a GCP.



Note: The benefits of a GCP are to shorten time to recovery and increase the capacity of rapid response and recovery.

Source: Adapted from Beniya (2016) and the Cabinet Office of the Government of Japan (2015).

Differences between GCP and other disaster risk management plans

A GCP has a different function in disaster risk management than other DRM plans (Table 1). For example, regional disaster prevention plans in Japan do not assume that municipal governments would not be damaged by disasters and, thus, lack the notion of continuity of operations (Japan Society of Civil Engineers, 2012).

Table 1: Differences between Regional Disaster Risk Management Plan and a GCP

	Regional Disaster Risk Management Plan (What to do)	GCP (How to do)
Goal	To specify the division of roles	To complete prioritized tasks by a targeted time under a constraint of resources
Impacts on governments	It is not always assumed that governments will be impacted. How to continue government operations is not always mentioned.	It is assumed that governments will also be impacted by disasters. It is assumed that resources (financial, human, lifeline, and machines) will be reduced due to disasters.
Works of the scope	To scope all the phases of DRM (prevention, mitigation, response, recovery, and reconstruction)	To prioritize works for emergency response. To prioritize peacetime works that need to be done during emergencies.
Targeted time to resume works	A target time for recovery is not always specified.	A target time for recovery is specified.
Securing water, food, and electricity	How to secure water, food, and electricity for staff is not always described.	How to secure water, food, and electricity for staff engaged in emergency response and recovery is described.

Source: Table 1 of the Cabinet Office of the Government of Japan (2010)

6. Analysis of the Guideline of a GCP

In general, a GCP targets national and local governments as well as public organizations, including lifeline service providers offering critical infrastructure (Clark & Wilairat, 2009). This section of the paper summarizes a guideline produced by the Cabinet of Office of the Government of Japan (2015), which specifies the basic principles of a GCP. The guideline proposes critical six items for a GCP.

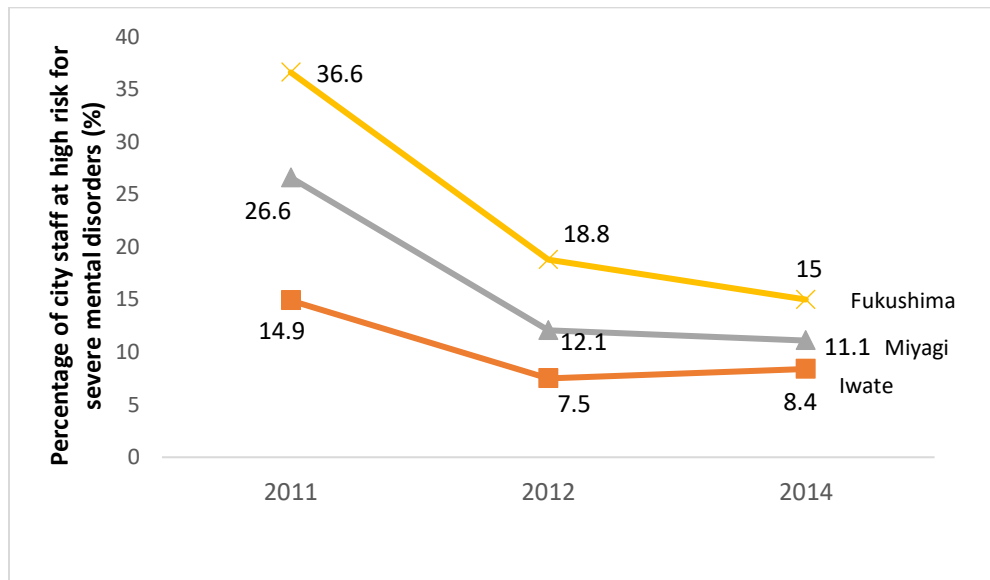
Item 1: Clarifying decision-making when a mayor is absent and how to gather staff in case of emergencies.

Clarifying the decision-making process is critical to avoid delaying emergency response and recovery. If a mayor is absent, the decision-making process will be delayed without an adequate succession of authority. For example, in 2013, flash floods isolated Izu-Oshima Island, Japan; the mayor and vice-mayor were not on the island due to business trips when forecasters warned of a massive typhoon expected to hit the island. The island's crisis management system was criticized for not delegating authority adequately. In a GCP, all critical positions should appoint at least three successors (Clark & Wilairat, 2009; The Cabinet Office of the Government of Japan, 2015). It is also critical to train a mayor and assigned successors in crisis management because they are usually not trained on such areas (Comfort, 2007).

A GCP also has to determine how to gather staff during emergencies. Sometimes a regional disaster plan does not consider how many city officials can come to the office. However, there is a possibility that a large number of city officials will not be able to access the office because of disrupted transportation systems or the need to rescue neighbors or family members. For example, during the 1995 Hanshin-Awaji Earthquake (or known as the Kobe Earthquake), it took the mayor and vice mayor almost two hours to move in 5 km (3 miles) to come to the city hall (Johnson & Olshansky, 2017). Moreover, only 41% of city staff were able to come to the office on the day of the Kobe earthquake, which occurred around six o'clock in the morning (The Cabinet Office of the Government of Japan, 2016).

Adequate management of staff and officials during responses to mega-disasters is critical. After the GEJE, in Miyagi Prefecture, one of the three worst-affected prefectures, 35% of staff from coastal areas affected by the tsunami reported a high risk of post-traumatic stress disorders while 13.5% of staff from inland areas not affected by the tsunami's impact reported a high risk of such disorders in 2012 and 2013 (Kuwahara, Takahashi, & Matsui, 2015; Takahashi, Kuwahara, & Matsui, 2015). Even three years after the earthquake, city staff was experiencing high-stress risks on average (8.4–15.0% compared to the average 3% among the general public in Japan) (Matsui, 2018) (Figure 5). Also, the mayor of Kobe City had to stay in the office and could not go home for more than two months (Johnson & Olshansky, 2017). Losing governments' human resources would cause delays in response and recovery efforts.

Figure 5: Percentage of city staff at high risk for severe mental disorders in a general health questionnaire (GHQ).



Note: The average statistics among the general public over all of Japan is 3%. In Iwate, Miyagi, and Fukushima, which are severely affected by the GEJE, city staff were experiencing high-stress risks on average. Source: Matsui (2018).

Item 2: Identifying a backup office when disasters have damaged the main city hall

A city hall or major facility should serve as a hub for emergency response and recovery efforts. However, there is a possibility that disasters will damage the main city hall. For example, the 6th floor of the main city hall of Kobe City was destroyed by the Hanshin-Awaji Earthquake, preventing city staff from entering the building (The Cabinet Office of the Government of Japan, 2010). Therefore, it is important to specify several backup offices before a disaster happens. A backup office should be connected to resilient lifeline systems. These alternative sites and facilities should be geographically dispersed based on hazard maps in order to avoid simultaneous damages (Clark & Wilairat, 2009). Also, it is recommended to identify a facility close to other government bodies to ensure quick coordination during emergencies (Clark & Wilairat, 2009).

Item 3: Securing electricity, water, food, and office supplies for staff

Governments need to prepare for securing access to electricity, food, water, and office supplies for ongoing operation during emergencies. Electricity for facilities and devices is indispensable for emergency response and recovery efforts. Governments should also prepare for blackouts by storing backup generators. The sites for storing backup generators should be selected carefully. For example, if backup facilities are located underground, measures to prevent flooding must be implemented in advance. It is recommended to store at least three days of fuel for backup generators. In addition, it is vital to secure food and water for staff who will carry out response and recovery efforts because it is possible that, during emergencies, food and water might not be available due to supply chain disruptions. In addition, it is important to secure a method for transporting food and water. Finally, expiration dates should be regularly monitored.

Item 4: Securing communication tools during emergencies

It is vital to secure communication tools so that decision-makers and staff who will take charge of emergency response and recovery efforts can communicate effectively during emergencies. Diverse communication tools should be secured because one type of communication tool might not work during emergencies. For example, 70%–95% of landlines and 80%–90% of cell phone lines could not be used during the GEJE (Masuda, 2012). During Hurricane Katrina, the significance of well-designed communication and information systems was also recognized in the case of intergovernmental coordination (Comfort & Haase, 2006). It is recommended to have redundancy in communication mode while considering the interdependence between social and technical systems in managing disaster risk (Comfort & Haase, 2006).

Item 5: Making a backup of critical government data

Having redundancy is also vital for resilient data management. During the GEJE, the town of Otsuchi lost its original copies of the Basic Resident Register—vital items for response and recovery— and the server that saved the electronic data of the register was damaged by the tsunami (The Cabinet Office of the Government of Japan, 2016). It took three months to recover all the data (The Cabinet Office of the Government of Japan, 2016).

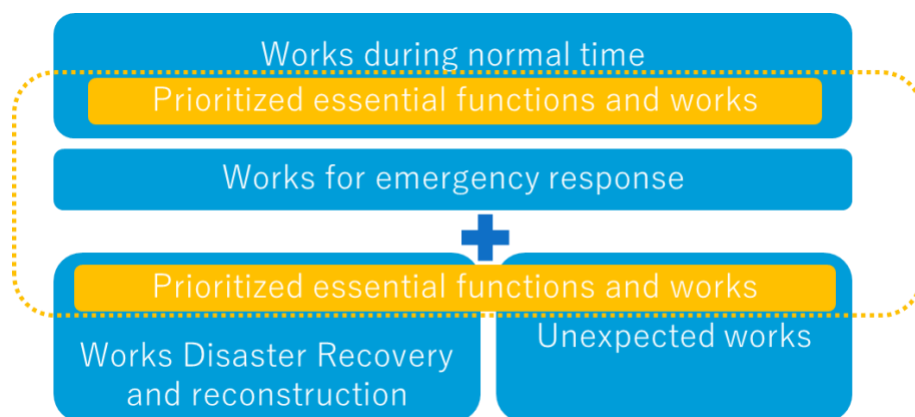
Two types of data should be protected during emergencies (Cabinet Office of the Government of Japan, 2016). The first type is data that only local governments own and none can restore if local governments lose them. The example includes data related to tax payments, lifeline fares, public pension and insurance, business and land

contracts, and others. Another type is data necessary for emergency response and recovery efforts, such as records related to disabled people and people who need nursing care, records related to critical infrastructures (such as lifeline, transportation, and communication) and records related to foreign resident registration.

Item 6: Prioritizing essential works and functions during emergencies

To ensure rapidity and robustness during an emergency response, prioritizing essential functions and works in advance is critical. Two types of functions and works should be prioritized by governments in advance (Figure 6). The first type is works and services carried out even during peacetime but need to be prioritized during emergencies. These include care services for the elderly and disabled people, pension provisions, and others. The second type is works and services special for emergency response and recovery efforts, such as issuing victim certificates, building evacuation shelters, and providing emergency goods to victims. It is important to prioritize works with targeted starting times (for example, within 72 hours) and recovery time (for example, complete a task within three weeks). There is a tendency to see disaster planning as a separate product from day-to-day planning; however significant daily tasks cannot be eliminated during disaster response.

Figure 6: Image of prioritized works.

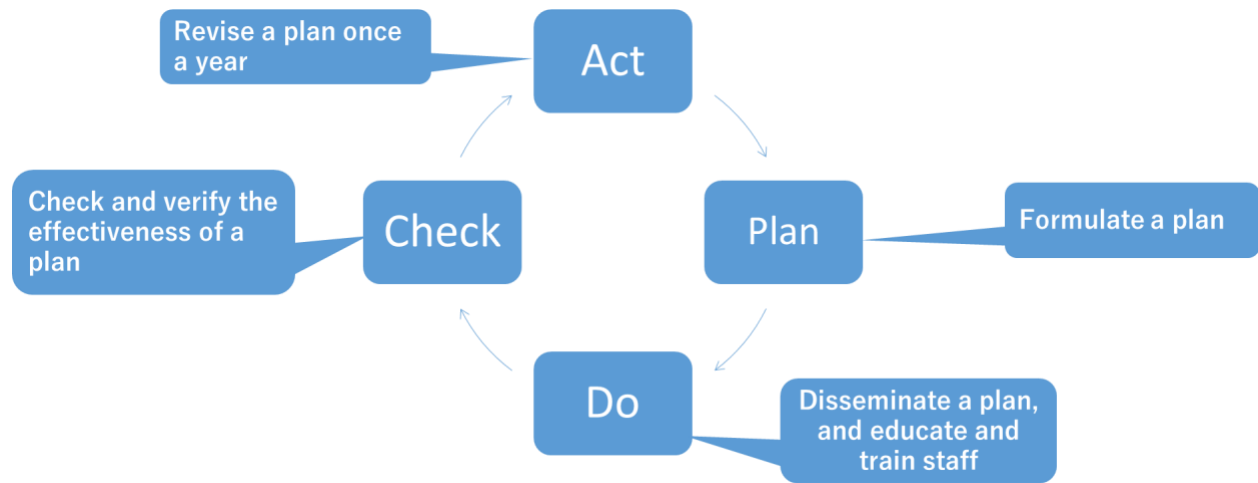


Source: The Cabinet Office of the Government of Japan (2016a)

Other important items

In addition to these critical items identified by the Cabinet Office (2015), there are other important issues regarding government continuity plans. First, establishing a system to receive outside support is a must (The Cabinet Office of the Government of Japan, 2017a). Human resources are likely to decline; such declines need to be compensated for with outside supports. The amount of work will also increase during emergencies. To compensate for declines in human resources and increases in work, supports from outsides (e.g., national government, other local governments, donors, NGOs) are indispensable. Furthermore, mega-disasters are low probability disasters (e.g., occurring once every hundred years), which means that governments' city staff have most likely never experienced operations during mega-disasters. City staff is not experts in running shelters, conducting a rapid damage assessment, or issuing suitable documents for public support to affected citizens. Therefore, it is crucial to receive support from outside agencies experienced with mega-disasters. Second, it is essential to make a list of emergency contacts both inside and outside of governments, such as lifeline companies and collaborators (Cabinet Office of the Government of Japan, 2016). Lifeline agencies include electricity, gas, public transportation, water supply and wastewater, internet, and communication. Collaborators include the police, the fire department, hospitals, the national government, donors, NGOs, and others. Third, the process of making a GCP should be a continuous effort. Effective GCP requires the continual updating of the plan (Cabinet Office of the Government of Japan, 2016). Therefore, it is crucial to act based on the plan, do, check, and act (PDCA) cycle: formulate a plan, disseminate the plan and educate and train staff, check and verify the effectiveness of the plan, and finally revise the plan at least once a year (Figure 7). Through this PDCA process, it is vital to engage responsible organizations and stakeholders in a regular process of communication and action, as recommended by Comfort (1994).

Figure 7: Plan, Do, Check, and Act (PDCA) cycle of a GCP.



Note: It is important to revise a plan once a year. Source: The Cabinet Office of the Government of Japan (2016)

7. Discussion

Assessment of the GCP guidelines from the perspective of Complex Adaptive Systems

Reviewing the events of the Pittsburgh oil spill in 1988, Comfort (1994) identified the following five essential conditions that facilitate the emergence of self-organization in disaster operations:

1. Structures to exchange information
2. The flexibility to adjust behavior to dynamic changes in behaviors of other actors
3. Shared goals among actors
4. Recurring opportunities for interaction
5. The capacity to integrate information in a knowledge base that serves as a foundation for informed action

The GCP guideline made by the Cabinet Office of the Government of Japan (2016) has the following strengths regarding critical items for self-organizing communities (Comfort, 1994). First, the GCP guideline Item 4 intends to develop information exchange systems. This is one of the four recommendations for increasing self-organization in the community management for a crisis made by Comfort (1994). Second, the GCP guideline suggests the plan be made publicly available. This will help stakeholders understand goals and visions for response and recovery. Shared

goals represent one of five critical conditions for the emergence of self-organization. Third, the guideline recommends the establishment of a system to receive outside support and the complication of a list of emergency contacts both inside and outside governments as discussed in Section 4. This would provide recurring opportunities for interaction. Organizations with recurring opportunities for interaction during the crisis are more likely to adjust their behavior mutually to achieve the shared goal of returning to normal operations (Comfort, 1994).

Some points of Japan's GCP guidelines need further development, however, to conform to recommendations for self-organization (Comfort, 1994). First, Japan's GCP does not provide for the flexibility self-organization demands in order to adjust behavior to dynamic changes in behaviors of other participants (Comfort, 1994). The capacity for adaptation to a rapidly changing environment is vital, given the possibility that available resources will decline during a crisis (Comfort, 2007). Using the organizational typology proposed by Harrald (2006), a GCP needs to be designed to make a balance between agility and discipline, namely type 3: Balanced and Adaptive organization in the typology of Harrald (2006). The GCP guideline can be improved to include guidance of flexibility during emergencies. Maintaining the flexibility characteristic of self-organization requires accurate feedback from participants affected by actions taken in response operations (Comfort, 1994). Therefore, in preparing for a GCP, it is important to establish a system that can receive feedback from stakeholders before, after and during a disaster. The Japanese guideline does not yet have such a feedback mechanism.

A second shortcoming of Japan's GCP is that it does not create a robust common knowledge base of the sort vital for collective action during a crisis (Comfort, 2007). The capacity to integrate information in a dynamically updating knowledge base can serve as a basis for emergency managers to make an informed decision (Comfort, 1994, 2007). This capacity will enhance the manager's capability to make informed, timely decisions under dynamic emergencies (Comfort, 1994). In the language of practice, having a "common operating picture" would promote clear coordination of actions among emergency response organizations (Comfort, 1994). Furthermore, the lesson from the intergovernmental crisis during Hurricane Katrina informs that the common operation picture must be established *before* a disaster (Comfort, 2007). Without a common operation picture, emergency response operations tend to be hierarchical command and control (Comfort, 2007). Furthermore, different organizations receive critical information at different times and taken their own actions without considering a potential impact on other organizations. Hence, a back-up computer and IT system in a GCP need to have this capacity to integrate information dynamically. Then, a

GCP will contribute to the building of a common operating picture if it is adequately designed with common training, years of shared experience, and interaction among emergency managers.

In general, the interconnectedness of society makes it challenging for municipal governments to form GCPs. As lifelines and supply chains are interconnected (Haraguchi & Kim, 2016; Haraguchi et al., 2016), continuity of operations and businesses of other stakeholders will also affect the continuity of municipal governments' operations. Therefore, forming a GCP consistent with the BCPs of other stakeholders is vital (Haraguchi et al., 2016). More broadly, a GCP needs to incorporate a rich set of Area BCPs, Public-Private Partnership (PPP) BCPs, community-based BCPs. In addition, it is critical to identify bottlenecks in the evolving process where delays in one organization may cause a cascade of delays through the chain of organizations engaging in response operations (Comfort et al., 2010).

How a GCP will contribute to the government resilience

A GCP will contribute to enhancing resilience in terms of its quantitative measures, i.e. robustness, redundancy, resourcefulness, and rapidity (Bruneau et al., 2003) (Figure 8). Specifying the succession of authority (Item 1) contributes to increases in rapid, robust decision-making during emergencies. Identifying backup offices (Item 2), backing up critical data (Item 5), and securing various communication tools (Item 4) will enhance redundancy. Securing electricity, water, food, and office supplies (Item 3) as well as a way to gather staff (Item 1) and receive outside supports contributes to the increase in available resources during emergencies. Identifying prioritized works and services before a disaster (Item 6) will help ensure that city officials and decision-makers know what and how they have to do when an emergency happens, leading to rapid response and recovery. Johnson & Olshansky (2017) also support the benefit of formulating a pre-disaster plan since pre-disaster plans can improve the speed and quality of post-disaster decisions for response and recovery. In this sense, a GCP can serve as one of the pre-disaster plans for municipalities.

Figure 8: A Conceptual Image about How Critical Six Factors in the GCP guideline will Contribute to the Increase of Resilience.



8. Conclusion

The advancement of science and technology is enabling more clear, timely early warning systems for natural hazards, such as using remote sensing technologies (Haraguchi, Cian, & Lall, 2019). However, a bottleneck during an intergovernmental crisis often relates to a lack of risk cognition, coordination, communication, and control (Comfort, 2007), and consequently, a community fails to be self-organizing. This study analyzed the GCP guidelines produced by the Government of Japan from the CAS perspective, especially based on a self-organizing system. A GCP will complement regional disaster plans, which often focus on *what* governments should do during emergencies but fail to outline *how* governments should prepare for emergencies. Some regional disaster plans do not assume that governments' and municipalities' facilities will also be damaged by disasters and might lose their lifelines, offices, and staff, which are essential resources for rapid response and recovery efforts. This study shows how a GCP can contribute to Priority 4 of the Sendai Framework at national and local levels—namely, “enhancing disaster preparedness for effective response and to Build Back Better in recovery, rehabilitation, and reconstruction.” A GCP would help national and local governments as well as public agencies 1) update disaster preparedness plans, 2)

ensure the continuity of operations and planning of social and economic recovery, and 3) ensure the provision of essential services by governments and critical infrastructure in the post-disaster phase. GCP will be strengthened with the promotion of regular disaster preparedness in addition to response and recovery exercises in the public sector. The analysis of this study also demonstrates that an effective GCP will help promote cooperation among diverse institutions.

However, several challenges remain for a study of GCP as it is still in its infancy in the area of disaster preparedness. First, future studies need to quantify the effectiveness of GCPs regarding the time and quality to recover. The current study only qualitatively assesses the effectiveness and necessity of a GCP.

Second, various continuity plans in a society need to be coordinated because continuity plans and management have been discussed at various levels of society. For example, continuity plans for business (Kato & Charoenrat, 2017; Montshiwa, Nagahira, & Ishida, 2016), community (Hatakeyama et al., 2013; Li, 2015), and industrial clusters (Baba et al., 2015) have been discussed. Studies that examine the connection of these different continuity plans are necessary.

Finally, the future study must examine how to share knowledge experiences among different communities, municipalities, and countries for low-probability and high-consequence disasters. Because catastrophic disasters rarely happen, most city officials have never experienced them when they do occur. For this reason, different governments tend to fail in learning from others' experiences and to make the same mistakes in different locations. In this sense, the creation of a system by which every government can share their experiences to prepare for catastrophes in each municipality is critical. A guideline, such as the one made by the Cabinet Office of the Japanese government, would help municipalities meet the need and identify critical components for the continuity of operation among municipal governments. Every layer in a society contributes to the resilience of the whole society (Haraguchi et al., 2016). Thus, enhancing the resilience of municipal governments is critical for community resilience.

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