The emergency stack: reshaping city institutions for crises and disasters

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Cities have always had to handle emergencies. But in recent years emergencies have moved from being exceptional to becoming ever more normal. Climate instability is one factor, that's multiplied problems with heat and floods. But so are the patterns of an ever more connected world that spreads pandemics, cyber-attacks and terrorism across borders. This new reality is forcing cities to be much more agile in reconfiguring capabilities very fast in response to emergencies of all kinds, from the broadly predictable to the very surprising. In this paper we map the many ways in which cities currently organise for emergencies across the world, with operations centres, specialist emergency services, task forces, and community-based arrangements, as well as coordination mechanisms with other tiers of government.

We then suggest an 'emergency stack' as a way of understanding both current practice and future options, showing how cities can pull together the different capabilities they need – including functions, roles and infrastructures - and covering everything from exercises to plan for crises and build up trust between the people who will have to work together in moments of extreme pressure, to standards that allow interoperability between communication systems. The need for a mix of patient long-termism (scanning and preparing for possible crises) and great speed to respond in the moment makes this new era of 'normal emergencies' very different from the traditional tasks of city administration. Finally, we show how the stack can be used as a diagnostic and design tool by city leaders.

About TIAL

The Institutional Architecture Lab (TIAL) works to improve the global practice and theory of designing institutions better able to meet the great challenges of our times. Formed in 2023, TIAL brings together researchers, practitioners, and policymakers worldwide to reimagine how public institutions are designed and reformed across domains such as digital governance, demographic change, cities, and climate.

This paper is part of a broader effort TIAL is conducting on how city governments imagine, build, and transform their institutions, with support from Bloomberg Philanthropies. The programme helps cities build their institutional design capacities and supports the creation of next-generation institutions suited to the challenges of the late 2020s. It runs across three work streams. The first scans current institutional forms and speculates on new ones for issues like the one covered in this paper. The second brings people and institutions together to build a community of city-level institutional design practitioners. The third codifies practices into an institutional design playbook, an interactive resource for city leaders.

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1. Introduction

In March 1888, a blizzard put New York under more than half a metre of snow, with strong winds reaching houses, railways and wires, which collapsed under the weight of ice. Fire stations were immobilised, the Stock Exchange closed for two days, and an estimated two hundred people died in the city alone. Even the mayor got stuck at home for the duration of the storm.

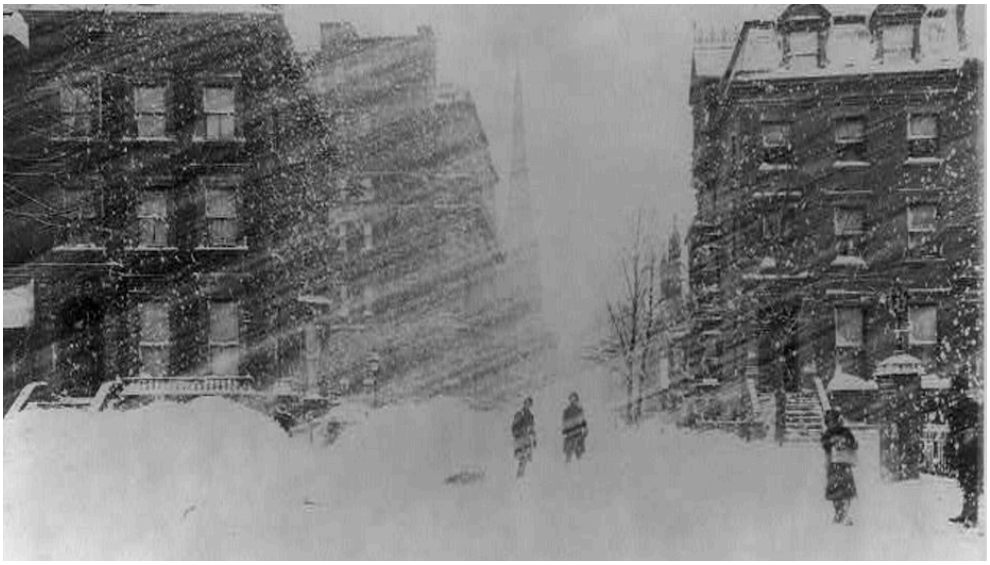
A year later, in Rio de Janeiro, then capital of Brazil, a different kind of emergency unfolded. Two months of drought had collapsed the city's already fragile water supply. Yellow fever was spreading. Authorities had retreated to the cooler air of nearby city Petrópolis, while in the city, the press denounced a monarchy in decline. Under public pressure, the government ended up accepting an unsolicited offer from a young engineer who promised, against the six months that official authorities had claimed were necessary, to bring water to the capital in six days. He then coordinated a massive task force to build the infrastructure and end the water crisis.

Managing emergencies is not a new function of city governments. It is among the oldest. The two examples were different, but show how cities have long had to act when severe events hit. What's changed, however, is the scale, speed and interdependence of risks, from climate to pandemics to cyberattacks. We have shifted from localised to prolonged complex emergencies, capable of triggering cascading disruptions across society.

Governments are expected to guarantee essential services and critical infrastructures that sustain life: this is why better handling of emergencies is so vital to public trust and legitimacy. It requires a combination of technologies and organisational arrangements to monitor risks, coordinate responses and learn from experience, connecting not just authorities and emergency services, but also infrastructure providers and communities.

This dossier explores how cities are organising for emergencies - from India and Brazil to the US and South Africa - and suggests options for the future. It focuses on how to organise the emergency stack: a framework to map and arrange what an emergency system must do, who carries those functions, and which enabling conditions make coordination work in practice. Most cities still default to traditional, top-down models,

which can be adequate for familiar hazards but are no longer optimal given the likely challenges of the years ahead.



A street scene in New York City during the Blizzard of 1888. (C.H. Jordan/ Library of Congress)

A satirical cartoon on Rio's 1889 water crisis, published days after a task force delivered 17 million litres of water in six days. By Angelo Agostini, *Revista Illustrada*. (Hemeroteca Digital / Biblioteca Nacional do Brasil)

2. Defining the questions

All cities face dilemmas in preparing for emergencies, whether they are fairly regular ones or very low-probability but high-impact ones:

- Which parts of a city's emergency system should be shared across hazards, and which should be hazard-specific?
- Whose job is it to monitor, assess and respond?
- How should they cooperate with other tiers of government, regional and national?
- How should they balance resources devoted to preparing for disasters and resources devoted to responding to them?
- How should they work with communities given their crucial role in ensuring effective emergency response?
- How should they connect to businesses which play critical roles - from mobile phone networks to energy supply and big employers?
- How should they learn from each emergency so that they prepare better for the next ones?

These questions rarely have simple answers, partly because emergencies and disasters vary greatly: some follow predictable patterns (including extreme heat, some floods and fires), while others are more chaotic and novel (such as new pandemics, cyberattacks and terrorism). Most cities are still answering them by default rather than by design, reaching for familiar and established forms rather than asking whether these remain optimal.

3. Current examples of institutions for emergencies

Most cities built their emergency systems incrementally, adding specialised agencies, task forces, and operations centres in response to crises rather than designing under calm and stable circumstances. The result is a familiar pattern: strong on functions close to response, weaker on those related to anticipation and learning, with roles that operate in parallel involving actors that quite often do not see or interact with each other's work properly. The examples below are organised not by geography or size but by the institutional forms, moving from traditional ways of coordinating response (in

centralized bodies) to more flexible approaches. This sample was selected to help city managers recognise current options, and serves as a starting point for imagining new options for the future.

3.1. Centralised intelligence: operations centres

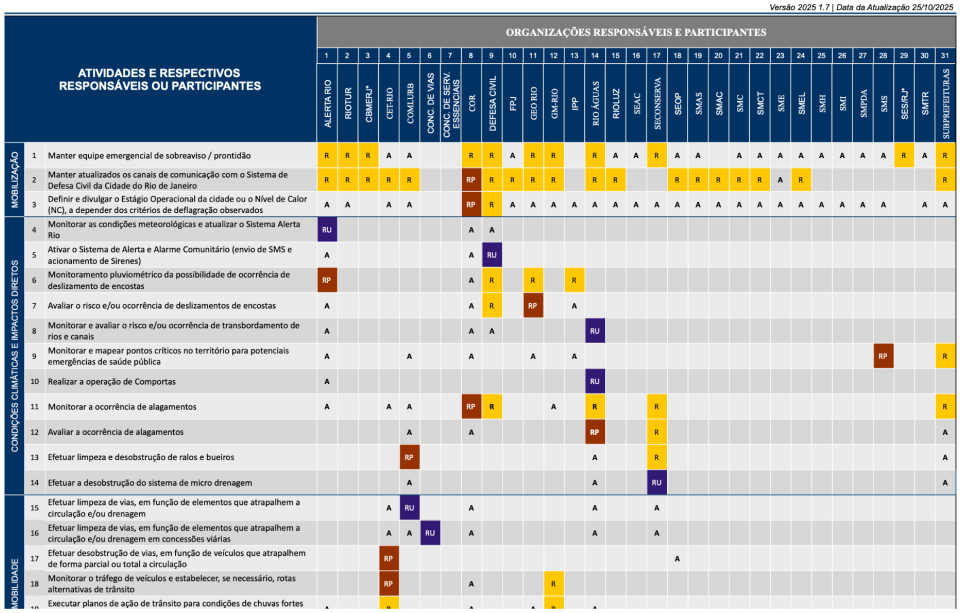
Operations Centres are 24/7 units that monitor risks and disasters with real-time data and coordinate multiple agencies and professionals during emergencies, supporting decisions by authorities using a common physical space as one of the key features. Equipped with sensors, monitors and dashboards, they produce live pictures of the city across many dimensions and turn them into rapid, coordinated action.

Successive floods and mudslides led to the establishment of Rio de Janeiro's iconic **Centre for Operations and Resilience (COR)**. In 2010, after heavy rains exposed coordination failures across municipal agencies, the mayor created a centre which later became a reference point for this type of institution. Created as a dedicated unit inside the Mayor's Office, COR serves as space for monitoring risks and coordinating action across over 30 city departments. Lighter than a formal department, but relying on other authorities' personnel and budget to enable the work of hundreds of staff, COR is fixed in space, but oscillates in size and shape depending on the occurrence of emergencies.

MATRIZ DE ATIVIDADES x RESPONSABILIDADES
RISCOS CLIMÁTICOS

Rio PREFEITURA

Versão 2025 1.7 | Data da Atualização 25/10/2025

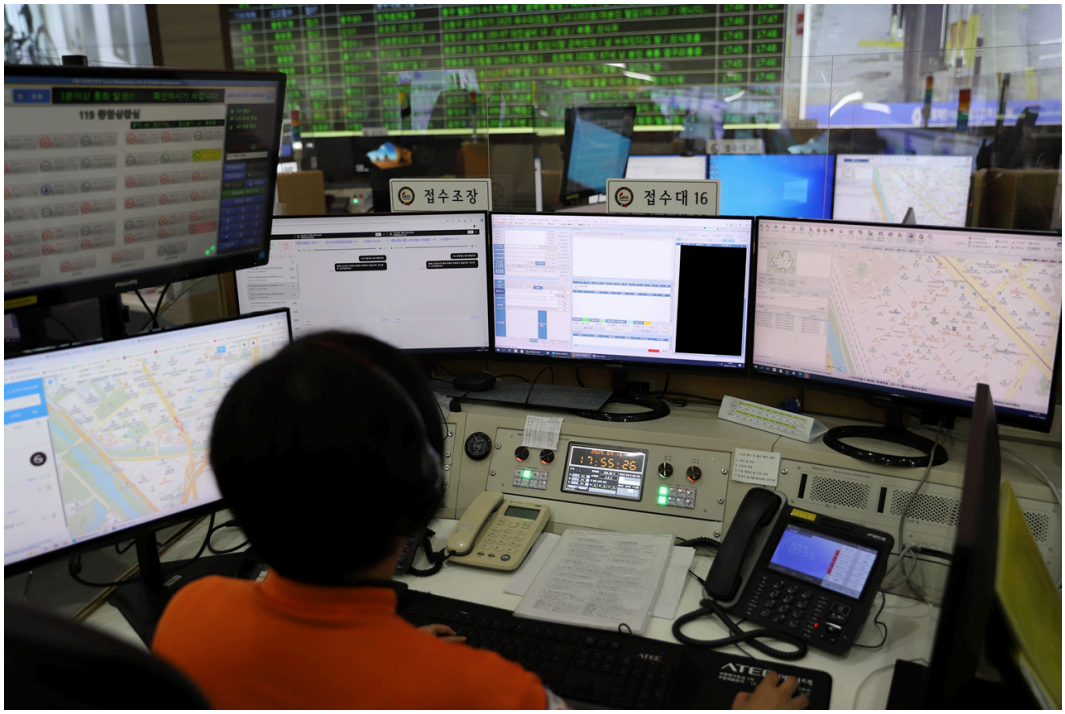


		ATIVIDADES E RESPECTIVOS RESPONSÁVEIS OU PARTICIPANTES	ORGANIZAÇÕES RESPONSÁVEIS E PARTICIPANTES																												
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
			ALERTA RIO	RIOTUR	CBMERJ*	CET-RIO	COMLURB	CONC. DE VIAS	CONC. DE SERV. ESSENCIAIS	COR	DEFESA CIVIL	FPU	GEO RIO	GM-RIO	IPP	RIO ÁGUAS	RIOLUZ	SEAC	SECONSERVA	SECIP	SMAS	SMAC	SMC	SMCT	SME	SMEL	SMH	SMI	SMPDA	SMS	SESRJ*	SMTR	SUBPREFEITURAS
MOBILIZAÇÃO	1	Manter equipe emergencial de sobreaviso / prontidão	R	R	R	A	A			R	R	A	R	R		R	A	A	R	A	A		A	A	A	A	A	A	A	A	R	A	R
	2	Manter atualizados os canais de comunicação com o Sistema de Defesa Civil da Cidade do Rio de Janeiro	R	R	R	R	R			RP	R	R	R	R		R	R			R	R	R	R	R	A	R							R
	3	Definir e divulgar o Estágio Operacional da cidade ou o Nível de Calor (NC), a depender dos critérios de deflagração observados	A	A		A	A			RP	R	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A		A	A	
CONDIÇÕES CLIMÁTICAS E IMPACTOS DIRETOS	4	Monitorar as condições meteorológicas e atualizar o Sistema Alerta Rio	RU							A	A																						
	5	Ativar o Sistema de Alerta e Alarme Comunitário (envio de SMS e acionamento de Sirenes)	A							A	RU																						
	6	Monitoramento pluviométrico da possibilidade de ocorrência de deslizamento de encostas	RP							A	R		R		R																		
	7	Avaliar o risco e/ou ocorrência de deslizamentos de encostas	A							A	R		RP		A																		
	8	Monitorar e avaliar o risco e/ou ocorrência de transbordamento de rios e canais	A							A	A					RU																	
	9	Monitorar e mapear pontos críticos no território para potenciais emergências de saúde pública	A				A			A			A		A															RP			R
	10	Realizar a operação de Comportas	A													RU																	
	11	Monitorar a ocorrência de alagamentos	A			A	A			RP	R			A		R			R														R
	12	Avaliar a ocorrência de alagamentos					A			A						RP			R														A
	13	Efetuar limpeza e desobstrução de ralos e bueiros					RP									A			R														A
	14	Efetuar a desobstrução do sistema de micro drenagem					A									A			RU														A
MOBILIDADE	15	Efetuar limpeza de vias, em função de elementos que atrapalhem a circulação e/ou drenagem				A	RU			A						A			A														
	16	Efetuar limpeza de vias, em função de elementos que atrapalhem a circulação e/ou drenagem em concessões viárias				A	A	RU		A						A			A														
	17	Efetuar desobstrução de vias, em função de veículos que atrapalhem de forma parcial ou total a circulação			RP															A													
	18	Monitorar o tráfego de veículos e estabelecer, se necessário, rotas alternativas de trânsito			RP					A				R																			
	19	Executar planos de ação de trânsito para condições de chuvas fortes	A		R					A			A	R		A																	

An example of a simple tool for organising the work across departments. (source: COR–Rio)

In practice, having a bit more elasticity is a key feature of institutions for emergencies, considering the potential rigidity of structures of command and control. Built around a smart cities narrative – with thousands of sensors spread across the city and dozens of monitors or dashboards to make sense of the city's data, Rio's example highlights a combination of data, technology and workspace design, ingredients also present in initiatives in Tokyo, Mexico City or Seoul.

The institutional locus of an operations centre varies across the cases. Rio's COR sits inside the Mayor's Office. Seoul Emergency Operation Centre is embedded in the emergency services machinery, inside the city's fire and disaster department. Tokyo's centre operates from the Bureau of General Affairs under the Governor, inside the core of the metropolitan government. Makati's center evolved into a permanent statutory department with its own staff, budget, and full-cycle mandate.



Monitoring the AI callbot at the Seoul Emergency Operations Centre

These arrangements show different ways the same function can be positioned, each at a different distance from political authority, operational frontline, and civil society.

Faced with multiple hazard types, **Seoul's** emergency operations have invested in shortening the time between signals and coordinated response. In 2025, Seoul began deploying an AI-powered emergency callbot, reducing citizens' waiting time to report emergencies. The system handles incoming calls in parallel, clusters and prioritises the cases that need a human operator. Alongside the callbot, a video monitoring system for highly dense places generates automatic alerts.

Seoul illustrates a move towards automation. One of the challenges is to ensure that automated prioritisation does not displace the judgment required for unfamiliar events, that operators can question what comes out of the dashboards, and that responsibility remains legible when the system gets it wrong.

Operations centres illustrate how citizens imagine what a city hall can do, being central to represent images of what smart cities look like in practice. In addition to the branding dimension, those centres intend to increase coordination capacity, as they bring together multiple departments to the same workspace. The concentration of

intelligence through professionals in a single room equipped with monitors, dashboards, and situation rooms aims to monitor and act on signals from mudslides and floods, to social media and traffic flows during big events. One of the risks is overrelying on what dashboards show without judgment from the edges of the system. In that sense, there is a need to complement centralized information with constant search for points of failure of the centre's assumptions, data feeds, or incentives. There should be ways to handle situations when the data says one thing and operators on the ground say another.

3.2. Permanent agencies

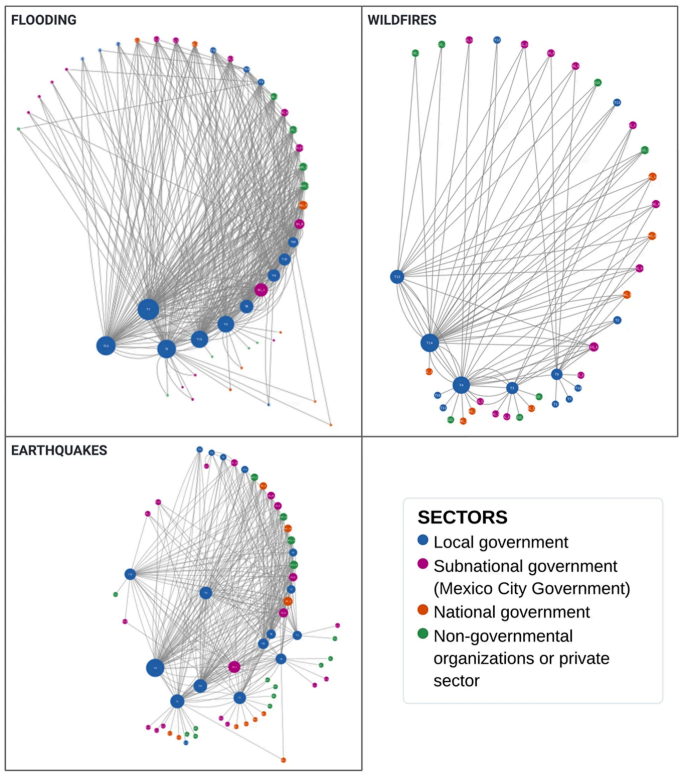
There is also a certain type of institution in the form of dedicated departments or commissions with mandates covering the full cycle of disaster and emergency management. The shape and depth of those institutions is influenced by the emergencies each city has lived through.

New York's emergency management agency was elevated to a standing city agency after the 2001 attacks. Mexico City's current secretariat was created in 2019, in the wake of the 2017 earthquake. The occurrence of certain disasters justifies the creation and reform of such units, building organisational capabilities that can be activated without reinventing the wheel each time. Emergency management agencies are marked by professional disaster risk reduction skills, and represent an intent to build expertise across hazards, concentrating know-how under a single institution.

Mexico City was built in an area which used to be a lake, close to active volcanoes, and is thus exposed to earthquakes, flooding and extreme heat. The city has been building its disaster governance since the 1985 earthquake, which catalysed the creation of the national civil protection system and the city's first dedicated emergency authority. The 2017 earthquake, which struck on the exact anniversary of 1985 and triggered a second round of reform.

The current agency, **Secretariat for Integrated Risk Management and Civil Protection**, was created in 2019 by merging the city's Resilience Agency (2017–2019) with its Civil Protection Secretariat. It is the city's second major emergency authority

redesign since 1985. The 2019 law created the agency and also a mandate to prevent new risks, reduce existing ones, respond to emergencies, and reconstruct better after them. It also formally establishes a city-wide system: the Secretariat coordinates not only the sixteen borough civil-protection units, but also the city's autonomous bodies, voluntary groups, research centres and civil-society organisations registered to operate within it.



The nodes in the three networks represent local governments (blue node), subnational government or Mexico City Government (purple node), national government or Mexico Government (orange node) and non-governmental organisations (green node). Each panel represents a risk: earthquakes, flooding, or wildfires.

Source: npj climate action, 2024

The Secretariat maintains a risk atlas covering geological, hydrological, and climate hazards, requires every major public facility and large private building to operate an internal civil protection programme, and formalises community participation through a standing programme of trained neighbourhood volunteers. It coexists with the city's operations centre, known as **C5**, which sits under the security department.

New York City Emergency Management (NYCEM) was created in 1996 as a unit within the Mayor's Office, with a mandate to coordinate preparation, response, and recovery across multiple hazards. After the 2001 attacks destroyed the office's headquarters (still called Office for Emergency Management), the city approved a charter amendment that elevated it into a standing city agency with its own statutory

autonomy. Today, the office coordinates across more than seventy city departments and runs the city's emergency operations centre and hazard mitigation plans.

After-action review is part of the doctrine this agency operates under. The Citywide Incident Management System sets how those agencies coordinate during an incident and names the review as a required step. The agency publishes best practices on how those reviews are run: a debrief in the days after the event, a comparison of what happened against the plan that was in place, and corrective actions that feed into the next round of training. Also, the City and State Comptrollers produce their own assessments alongside them, sometimes pointing out where plans had not been updated as the doctrine expected. This highlights the importance of a learning and evaluation function as part of the core responsibilities of such agencies.

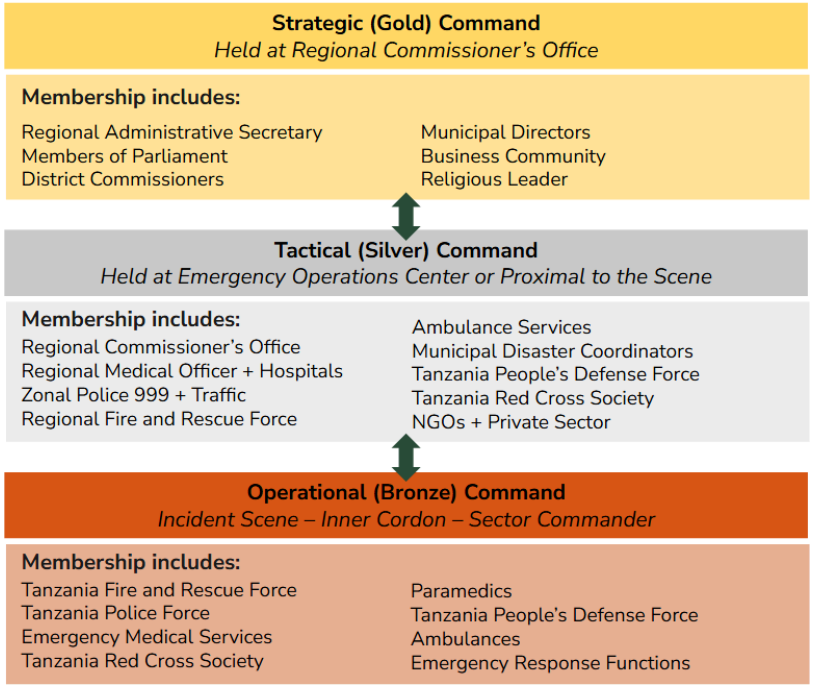
Agencies of this type are usually built under the all-hazards approach. The idea is that a single coordinating body can handle very different events through a shared command structure, common protocols and budget, rather than building a parallel bureaucracy for each kind of hazard. It is what spares a city from having one department for fires, another for floods, another for earthquakes, each with its own chain of command. Different risks share enough common features to be managed within a unified approach, improving coordination and letting resources move across events as they unfold.

In the Philippines, a 2010 national law required every local government to set up a permanent disaster risk and emergency office. **Makati City's Disaster Risk Reduction and Management Office** was the city's answer. The new office absorbed two earlier bodies — Makati Rescue and Makati's command, control, and communication centre, known as C3 — making Makati the case where the operations centre form was folded into a permanent agency. The office sits under the city mayor, runs a multi-hazard early-warning unit and a mobile reporting app for residents, and serves as secretariat to the city's disaster council. The same national law commits five per cent of every local budget to disaster work, giving the office a standing resource base across the country. Makati's community fabric is dense: every neighbourhood maintains its own disaster committee, and the city runs an annual citywide earthquake drill. Manila has a metropolitan entity and a regional disaster council sitting alongside it, but neither

holds authority over the seventeen local governments, so most disaster work stays at the city level.

In **Dar es Salaam**, a permanent agency emerged from a temporary one. In 2011, an explosion killed dozens of people and exposed deep coordination gaps in the city's response. First responders, frustrated by what had failed, formed a multi-agency team to fix it. That team was later made permanent as the Dar es Salaam Multi-Agency Emergency Response Team (DarMAERT).

In a context where floods and other emergencies were already frequent, the team was built to coordinate emergency operations as the tactical arm of the regional disaster management committee chaired by the regional commissioner. It brings together a core team with police, fire and rescue, the Red Cross, hospitals, ambulance services, and the coordinators of the city's five municipal councils. Eventually, the team expands and includes the meteorological authority, utilities, road agencies and NGOs. The following scheme shows the hierarchical command structure: the team operates at the tactical and operational levels, in support of the strategic level led by the Regional Commissioner's Office.



DarMAERT's hierarchical command structure

Between 2016 and 2022, the team was scaffolded by an external programme – the Tanzania Urban Resilience Program, financed jointly by the World Bank and the UK government. The accumulated practice was then codified into national law in 2022, which now requires similar coordination committees at every level of government. It is an example of function over formality, where practitioners do the work, only then followed by institutionalisation. The model has since been adopted by other Tanzanian regions.

Embedding disaster preparedness into the routines of government is part of what these full-cycle agencies do. Mexico City's annual simulation across all sixteen boroughs, New York's after-action reviews, Makati's citywide drill, or Dar es Salaam's training curriculum are activities to prepare not only how the city administrators themselves work, but how the city functions as a whole, engaging citizens and businesses.

Reading across the four examples, permanence appears to be a key aspiration for emergency and disaster agencies. In this section we showed they are products of events or crises that created the pressure for institutional change, that city hall then carried out. The question of how to embed learning in the life cycle of those agencies remains central to most examples, as they will keep facing familiar risks across old and new hazards. As the institution itself grows stronger, it should look after the failures and crises that will enable the new institutional changes.

3.3. Task forces

Task forces are temporary arrangements created to handle a specific crisis. They concentrate authority, sometimes suspend normal rules for the sake of speed, and dissolve once their objectives or deadline are met, producing an extraordinary institutional environment for as long as they exist. Examples include Cape Town's Water Crisis Management Committee (2018) and Porto Alegre's Office for Reconstruction and Climate Adaptation (2024). At a higher tier, Christchurch's Canterbury Earthquake Recovery Authority (2011–2016) shows this form at metropolitan scale.

Where operations centres are designed to outlast any single emergency and permanent agencies are built around an all-hazards mandate, task forces start from the

opposite premise: they are designed to be dissolved. Task forces sit closer to an authority, and are built from the urgency of the moment, and depend on capacity that is borrowed rather than “owned”. It is a familiar form, so people understand what it can do. What varies most is how it ends.

In late 2017, **Cape Town** entered its third consecutive failed rainy season. By the start of 2018, the city of four million was projecting **day zero**, the day municipal taps would be turned off and residents would queue to get water. The institutional gap was blindness, as no single entity could see or steer the system effectively. The National Department of Water and Sanitation held responsibility for South Africa's dams and main water supply, the provincial government held disaster declaration powers, and the city administration held the distribution network and the bill from residents.

In early 2018, the City established the Water Crisis Management Committee, reporting directly to the Mayor. It coordinated across departments and held the operational interface to province and national. Its mandate was narrow and time-bound: get the city through the 2018 dry season without reaching day zero. The disaster declaration came about four weeks behind the City's response.

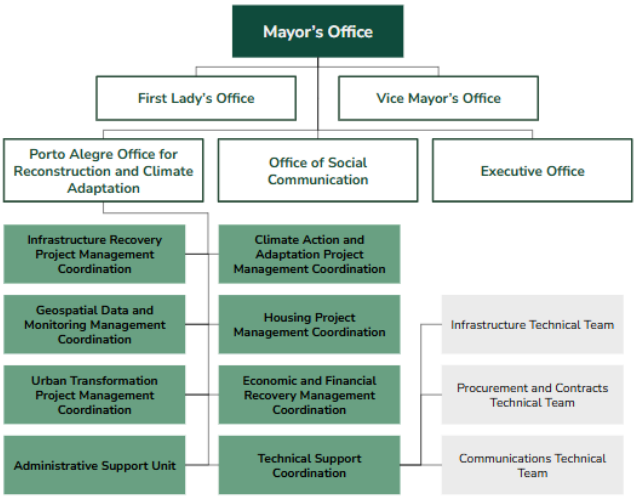
The committee did two things at once. In the short run, it ran the demand-side campaign, with daily per person limits, a pressure management programme, a public Day Zero countdown, that pulled consumption down sharply enough for the rains to refill the dams. In the longer run, it absorbed a few lessons. When the committee was dissolved, these lessons were folded into the City's Water Strategy and into a standing pipeline of new water sources – groundwater, desalination, and water reuse – to reduce dependence on rainfall, now housed inside the permanent Water & Sanitation department.

Christchurch in New Zealand did something similar at a bigger scale. After the 2011 earthquake, the central government created a recovery authority (CERA) with broad powers and a five-year expiry written into law. When the five years were up in 2016, the work was deliberately split across five successor bodies rather than handed to one. Both task forces were built to end. That is the form's strength and where its costs show up. Accountability gets harder when normal rules are suspended for speed. And the deepest problem comes at the closing moment: the people, knowledge, and

relationships built inside a temporary entity leave with it, unless someone has decided in advance where they will go.

Inundation in the Metropolitan Region of Porto Alegre (1st Crepdec). Source: WRI Brasil

In southern Brazil, the city of **Porto Alegre** experienced one of the most severe climate emergencies ever recorded in the country in 2024. Historic floods quickly inundated much of the territory, causing deaths, displacements and disruption of essential services. Response required rapid, coordinated action, but the greater challenge was turning emergency action into a viable reconstruction programme. Following two months of active response, the **Office for Reconstruction and Climate Adaptation** was created inside the Mayor's Office, with seven thematic units and a mandate to coordinate federal recovery funds, state infrastructure investment, and municipal works.



The organisational structure of the Porto Alegre Office for Reconstruction and Climate Adaptation

Originally scheduled to close at the end of 2024, the Office was extended twice, first through 2025, then through 2027, as the scale of reconstruction made each timeline collide with the climate adaptation planning that recovery demanded. The body that began as a single event became the standing structure for climate adaptation governance, not a task force that handed lessons back to existing departments, but a task force that became the executive department.

The contrast between beginnings and endings carries lessons worth keeping. All three examples began in similar shape – temporary, close to the authority, concentrated mandate, with a defined crisis to handle. Each then confronted the form's central design question: what happens to the knowledge and political capital built inside the temporary unit when the structure ends? Cape Town answered by absorbing the lessons into a single standing department whose mandate the crisis had clarified. Christchurch offered an alternative path, closing the body on its statutory date and distributing functions across multiple inheritors rather than concentrating them in one. Porto Alegre is answering by not ending at all: successive extensions of the expiry date have folded more of the task force's responsibilities into the office, and the office is becoming the standing department the city did not previously have.

Planning for the end is not hard. Implementing is the tough part. Task forces work because they are visible to the public and they can move at speeds the standing system cannot. Whether they leave the standing system stronger depends on what was built into the closing phase.

3.4. Distributing capabilities at the edges of the system

There is much evidence that social capital has a big influence on how well emergencies are handled: whether communities can quickly cooperate and coordinate, whether to evacuate or to provide food and shelter, and whether there are large groups of volunteers ready to spring into action, has a big impact on how much harm is caused by emergencies.

In some countries, there are long-standing traditions of civil engagement. Finland is a prime example, in which a third of the adult population are reservists and regular exercises link communities, business and government to prepare for possible invasions.

In many countries, better community engagement has become a higher priority, alongside the work of the professionals. Australia's overhaul of its firefighting capacities in recent years is a good example that has helped dramatically cut death rates during fires. As well as setting up national bodies (including a National Recovery and Resilience Agency set up in 2021), it also led to much more support for volunteers, influenced by research into communities affected by the 2019–20 fires, which found that including people not normally part of decision-making, such as youth, people in childcare, and those in isolated locations, was keen for recovery.

A University of Melbourne study of nearly 175 years of bushfires in the state of Victoria found that Australia's reform cycles – driven by royal commissions, inquiries and parliamentary reviews – have built a strong culture of institutional accountability and system-wide adaptation, leading to national warning systems, improved evacuation protocols, and clearer governance frameworks. But it warned that the risks continue to evolve faster than the institutions.

In Brazil, a comparable example is the Community Civil Defence Centres (NUDECs). **Petrópolis** was the Brazilian city with the highest number of landslides and floods in 2024. In this context, the city's 32 NUDECs play a pivotal role in disseminating guidelines for the prevention and mitigation of risks. In addition to having a direct interface with Civil Defence, the NUDECs occupy three seats on the Petrópolis Municipal Council for Protection and Civil Defence, as well as its vice-presidency.

By placing the community at the centre of their strategy, the NUDECs can establish a culture of resilience strengthened at the grassroots level, encouraging adherence to emergency management measures. Community assemblies and organisations like these stand out by combining different forms and fields of knowledge to generate situated strategies.

3.5 Interfaces between city, state and national systems

Many countries have elaborate arrangements to connect multiple tiers of government during emergencies. All US local emergency management follows the National Incident Management System (NIMS) and uses the Incident Command System (ICS) – a standardised hierarchy (command, operations, planning, logistics, finance) that allows agencies at local, state and federal levels to work together during a disaster. Cities

work upward through state agencies (such as the Florida Division of Emergency Management and California's Governor's Office of Emergency Services respectively) to the federal FEMA. For example, Miami-Dade County's Department of Emergency Management acts as the dominant coordinating body for the wider region, particularly for hurricanes. When a major disaster threatens, it activates its operations centre, which brings county agencies and partners under one roof. Los Angeles has a more complex structure and a primary focus on earthquakes and fires.

India is another good example, with the roles set out in the 2005 Disaster Management Act, that links the National Disaster Management Authority (NDMA), headed by the Prime Minister, and state-level authorities (SDMAs) which in turn collaborate with cities and district-level authorities (DDMAs), which are responsible for planning, coordinating, and implementing disaster management, headed by the District Collector.

Heat Action Plans (HAPs) set out the responses a city should take when a heatwave is declared, from providing water and oral rehydration salts to putting out advertisements on heat stress prevention and organising preventive heat training for health workers, schoolchildren, and the local community. India is estimated to have more than 100 Heat Action Plans at state, district, and municipal scales, with cities at the frontline of heat action planning.

Ahmedabad is the standout example internationally and became the first city in South Asia to develop a Heat Action Plan after the devastating 2010 heatwave caused over 1,300 excess deaths. It introduced colour-coded extreme heat alerts together with a protocol of actions that government agencies and civic stakeholders implement on high-heat days. On a red alert day, clinics activate heatstroke treatment protocols, ambulances are equipped with ice packs, construction workers adjust their schedules to cooler hours, and health advice is disseminated widely. Additionally, drinking water and buttermilk are distributed to vulnerable populations. Reducing heat exposure has also been tackled through the Cool Roofs Programme, with targets for implementing heat-reflective roofing on low-income houses and retrofitting AMC's own buildings and an urban afforestation programme.

3.6 Insurance as a cross-cutting lever and what happens when it fails

Insurance is part of the emergency stack in most cities, but it rarely appears in emergency governance plans. It operates as a preparation mechanism, pricing risk to discourage development in dangerous areas and funding rebuilding after events, without being formally managed as one. Houston makes the structural stakes of that invisibility concrete.

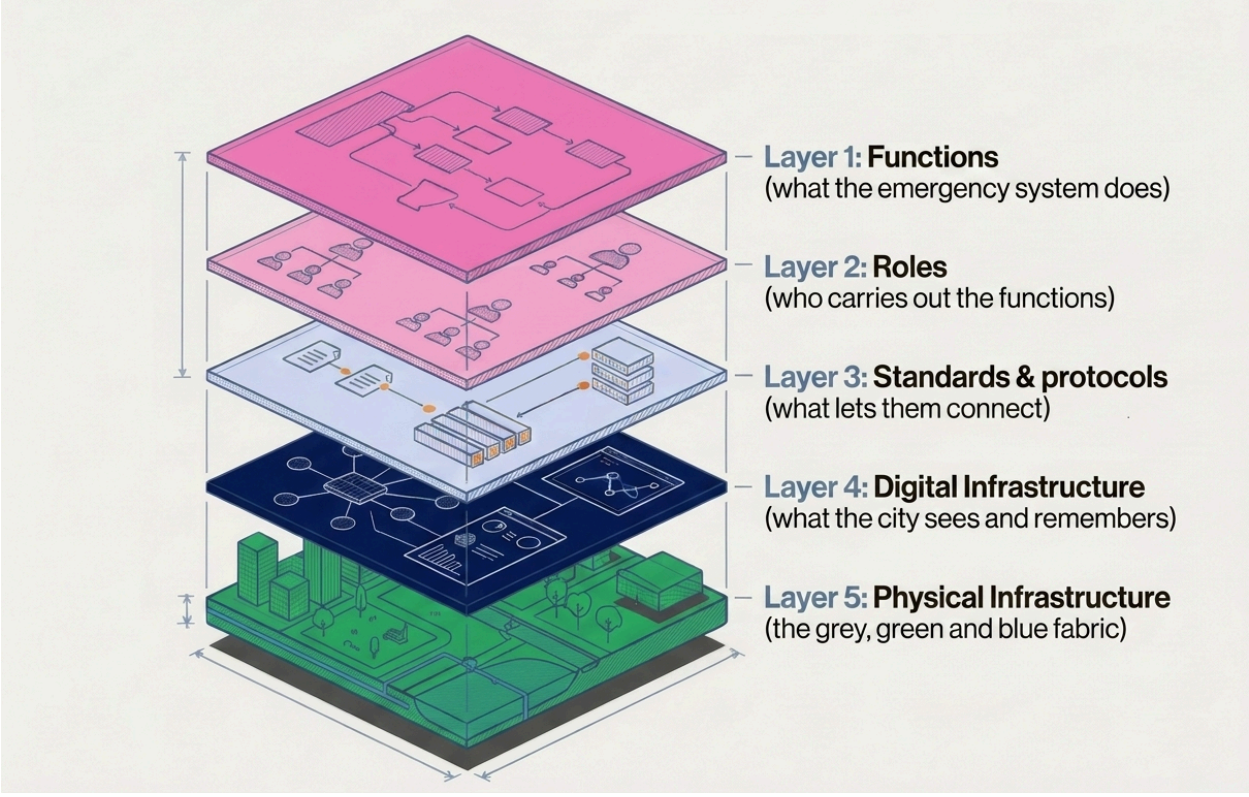
Hurricane Harvey in 2017 flooded thousands of homes in Houston. Of those, around two thirds had no flood insurance, not because their owners had declined it, but because they sat outside officially designated floodplain zones and were not required to carry it. The flood maps defining those zones had not been updated to reflect two decades of development and changing rainfall patterns. Harvey accelerated a structural shift already under way: the National Flood Insurance Program, the primary source of flood coverage in the US, carries over $22 billion in debt and is structurally unable to price risk at actuarial levels without political resistance. Private insurers are withdrawing from high-risk markets as reinsurance costs rise. Today, federal flood insurance policies for the area covers roughly 22% of housing units in floodplains, meaning around three-quarters of the county's 1.8 million homes carry no flood protection at all.

The consequence is that cities like Houston are managing the aftermath of emergencies with a financial layer that is progressively retreating from the places that need it most. The Houston case points to something that cannot be solved at city level alone: when the financial instruments that are supposed to distribute disaster risk are misaligned or retreating, city governments absorb the residual burden without the tools to fix the underlying structural problem. A different model exists. France's CatNat scheme is a mandatory surcharge on all property and motor insurance policies, pooled nationally and triggered automatically when a government disaster declaration is issued. It decouples insurance coverage from individual risk assessment, ensuring that flood-prone properties carry some coverage while distributing the cost broadly. The design of insurance as a preparation mechanism is a policy choice, not a market given and cities in countries where that choice has been made differently face a structurally different emergency stack.

4. Shaping the emergency stack

The cases in this dossier show how cities have built organisational capacity for emergencies. Each operations centre, task force, or agency works within a broader system, which means the real challenge for city leaders is not to build a sophisticated situation room, helpful as that may be. What cities need is to let different actors see each other and interact, so that the system performs each emergency function rather than only the ones a single body happens to own.

Traditional organisational charts struggle with this. They describe reporting lines in static terms, not the live interfaces across functions and roles that a dynamic system depends on. They show departments and units as if the context were stable, not the interactions that produce a response. In many cities, these representations of the institutional architecture remain the default.



We propose an *emergency stack* as an alternative design tool for cities. Borrowed from technology and infrastructure, a stack is a layered architecture in which each layer has a distinct job and depends on the others. Applied to emergency governance, the stack

separates things a city can examine independently, but simultaneously. Its defining feature is composability: the capacity to assemble and reassemble specialised components quickly, rather than forcing every emergency through a single, rigid administrative pathway.

The stack has five layers. The first two are the core: what the system does, and who does it. The other three are the conditions that let the first two work: the rules that connect them, the digital systems they run on, and the physical fabric of the city itself. The layers are ordered by how quickly a city can change them. Functions and roles can be redesigned in months, standards take longer to negotiate and test, digital infrastructure longer still through procurement and integration, and urban infrastructure is planned across years or decades. The order is a guide to lead time, not a chain of dependency: a city composes the layers into a working whole, and each can be examined and improved on its own.

Layer 1: what the emergency system does (functions)

The first layer describes core functions every emergency system must perform, whatever its governance model or current institutional forms. The functions are based on existing disaster risk reduction frameworks and are sequential in logic but concurrent in reality.

Monitor. Ongoing awareness of risk conditions, through different sensors, incident reporting, and local observation. Cities hold an advantage here, sitting close to signals on the ground that national systems sometimes miss.

Forecast. Turning signals into anticipation, including extremes. Many failures occur when models are calibrated to average events and break under tail risks. Cities rely on national services, but city teams still need to read forecasts against local infrastructure constraints and vulnerable populations.

Prepare. Institutional readiness, social capacity, and physical defences, and ensuring some of the other parts of the stack are in place: protocols, training, procurement, and drills, but also the everyday work of keeping systems ready (people, contracts, and arrangements that hold when pressure rises).

Respond. Action under time pressure, centralised or distributed depending on the hazard's speed and familiarity. The design question is whether authority, information, and logistics can be recomposed quickly when the event does not match the plan.

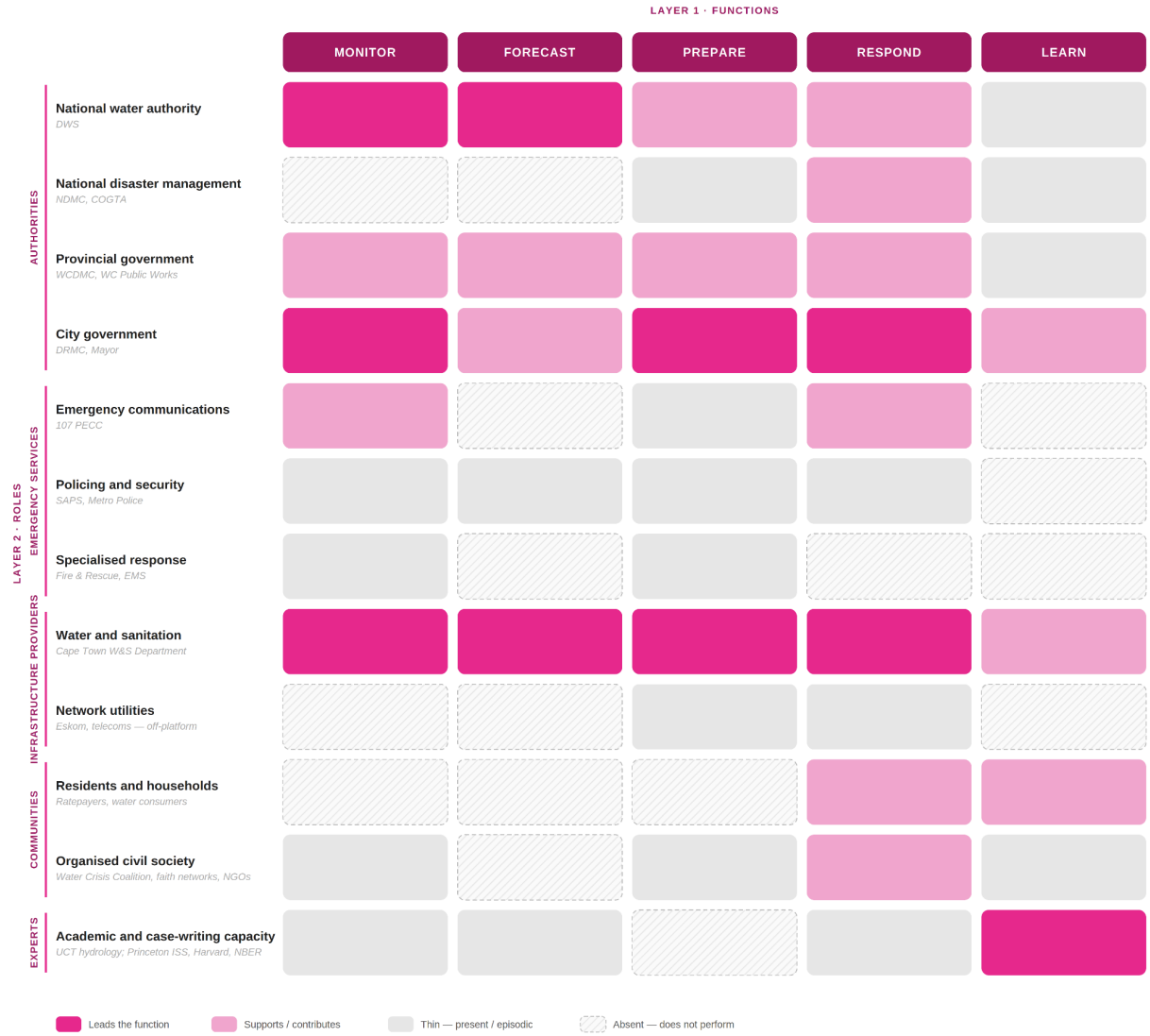
Learn. After-action reviews, revised protocols, and changes that show up next time. The stack treats learning as a permanent stream that updates monitoring, reshapes preparation, and changes response pathways. When a system runs the functions as a one-way sequence, the loop breaks and the same failures recur.

Layer 2: who carries out the functions (roles)

The second layer describes clusters of actors, defined not by sector but by the mandate each carries in the emergency system.

Role	Mandate	Who
Authorities	Declare emergencies, allocate resources, coordinate across tiers, set rules, hold legal authority and fiscal capacity	Mayors, ministers, council leaders, heads of departments, regional and national agencies
Emergency services	Run specialised response, sustain the routines tested repeatedly under pressure, hold operational memory	Fire, police, health, civil defence, disaster management agencies
Infrastructure providers	Maintain the city working, restore service after disruption, absorb or transfer risk, become decisive when those systems fail	Utilities, energy firms, telecoms, transport operators, insurance companies
Communities	Detect and report risk first, carry local knowledge, provide mutual aid, adapt behaviour, anchor legitimacy	Residents, neighbourhood organisations, civic and faith groups, mutual-aid networks
Experts	To evaluate crises in real time and provide advice to decision makers	Scientists, academics and experts of all kind, which can be organised in networks ready to be mobilised at very short notice when needed.

No single actor can carry all the functions. To orchestrate the system, roles need to be organised to make sure not only that mandates are clear, but also that everyone can coordinate with one another under stress. Disconnections between roles are often the binding constraint. Because all roles share the same territory, a failure in one quickly becomes visible across the others.



Interfaces between layers 1 and 2: Example from Cape Town stack (Day Zero)

Layer 3: what lets them connect (standards & protocols)

The third layer is the connective tissue of the system, bringing the shared rules and common language that enable shared risk understanding and assessment, so that many organisations and individuals can cooperate efficiently without the need to reinvent arrangements in every crisis. These include shared ways to ensure that a warning, a declaration of threat or emergency, or an incident means the same thing across agencies and society. And the operational rules that coordinate action: triggers, thresholds, escalation criteria, and handoffs.

Some standards are defined top-down, others emerge from practice and spread through use. The durable ones tend to be simple and comprehensive, as Jed Sunwall's paper explores standards as enablers of cross-cutting collaboration in scale. Considering the examples from our dossier, Ahmedabad's colour-coded heat-alert protocol translates a forecast into defined actions across agencies and society. Tokyo's *bosai* associations hold a standing protocol that connects neighbourhood groups directly to emergency services. Both grew from practice and gained force through adoption.

A few examples were described earlier. Mexico City's earthquake alerts have functioned for decades, yet there is a need to orchestrate institutions when it sounds. Cape Town's Day Zero exposed the same gap one tier up, with no clear protocol for escalating from local to provincial to national declaration.

Layer 4: what the city sees and remembers (digital infrastructure)

The fourth layer includes the data, communication, and knowledge systems the city draws on to see risks in real time, coordinate across organisations, and retain memory between events. Digital infrastructure shapes the quality of what the emergency system knows, and when it knows it. Protocols and standards help connect with other layers. The critical question for a city is whether these are aligned with the key tasks: how interoperable they are, and how easily mobilised in a crisis.

The cases show the range. Seoul's AI callbot clusters and prioritises incoming emergency calls, Cape Town's public water-consumption map made every property's usage visible during Day Zero, CDMX's C5 integrates emergency lines, thousands of

cameras, and multi-agency dispatch in one centre. Each extends what the system can see, but none removes the need for judgement at the edges, where the data runs out.

Layer 5: the grey, green and blue fabric (physical infrastructure)

The fifth layer is composed of the physical spaces, buildings and natural ecosystems of the city. These infrastructures are sometimes described as grey (drainage systems, flood defences, tunnels), green (urban forests, parks, etc), and blue (rivers, canals, wetlands, lakes, etc). Rather than just passive barriers, this layer functions as the city's vital systems. Together they absorb, redirect, or mitigate hazards before, during, and after an emergency, sustaining urban life.

Several cities are working on different urban transformation programs to work on this layer. From building green corridors in Medellin to reduce temperatures and create cooler areas, to Copenhagen's cloudburst plan reshaping streets and parks to hold and channel stormwater across the city's catchments. These efforts ultimately aim to guarantee the continuous operation of essential services against disasters.

5. Time and space

The stack describes what an emergency system is made of. How well it performs depends on two relationships that cut across every layer: time, or how institutions experience the speed, rhythm, and duration of problems, and space, or how the proximity of people, systems, and data shapes the flow of power and information. Reading the cases through these two lenses helps anticipate where the stack holds and where it breaks.

Time

The term golden hour comes from medicine, but disaster management uses it for the window in which a response succeeds or fails. This period is decisive for saving lives and stabilising a situation, and also for shaping public opinion and coordinating across

sectors. Quality information and rapid communication are therefore essential, which is why Seoul turned to AI to handle citizen reporting and protect the use of that window.

Knowledge accumulates in the teams that work an emergency, and it leaks away once they disperse. This brings light to the short memory of institutions. Permanent structures hold it better than temporary ones, as they systematically gather, retain, and transfer knowledge through training, publications, databases, and after-action reviews.

Technology serves this retention differently at different scales. Operations centres process large volumes of municipal data to find patterns, anticipate crises, and reconstruct event timelines. Community organisations work more simply but no less effectively: Tokyo's *bosai* network runs workshops teaching elderly residents to use preparedness apps and stages VR simulations to keep emergency knowledge alive between crises. The challenge is to balance response with memory, the rapid with the long-term. As technology accelerates coordination, institutions have to preserve the knowledge that makes the next response better.

Space

Knowledge does not flow freely across geography, it travels through social networks. The Chilean scientist César Hidalgo finds that knowledge moves far more readily between direct collaborators and shared connections than between strangers, and concludes that physical proximity matters less because distance constrains knowledge directly than because professional and social networks are embedded in space.

Emergency response inherits this constraint. Coordination depends on pre-existing relationships, and task forces succeed on networks formed in earlier emergencies. The NUDECs in Petrópolis work as neighbourhood-level nodes precisely because proximity allows face-to-face exchange between Civil Defence and residents.

Public institutions have long tried to overcome distance through technology while still leaning on proximity and co-location. The command-and-control room keeps reappearing, with video walls and dozens of monitors pulling images from cameras across the city into a central brain where teams synthesise and coordinate. These rooms enable real-time coordination at a metropolitan scale that earlier generations

could not achieve, but their spatial design sets their limits. Most focus on real-time pattern detection through sensors and dashboards; what cameras and sensors do not capture does not exist inside the room. That blind spot grows unless the distant view is complemented by lived experience on the ground.

Distributed models answer the problem differently. The Climate Emergency Software Alliance (CESA), operating in Indonesia and the Philippines, uses social-media chatbots to crowdsource disaster reports verified by community volunteers. Displayed on real-time maps, its platforms are open-source and replicable. Kyiv Digital shows the line need not be binary: built as a centralised services platform, it adapted under war to deliver alerts and crowd-sourced updates on which pharmacies, shops, and water points remained open. China's City Brain in Hangzhou and Shenzhen takes centralisation to its conclusion, integrating data on transport, energy, security, and services into one AI-enhanced operating system. The efficiency gains are significant, but the model depends on centralised state capacity and raises questions about transparency and citizen agency that distributed platforms handle differently.

The spatial dimension reveals a tension that runs through the whole stack: proximity builds tacit knowledge and trust, while coordination at scale needs some degree of centralisation.

6. Innovating when emergencies are the new normal

Nearly 140 years after the blizzard buried New York and the same year's drought collapsed Rio de Janeiro's water supply, both cities are back in the news. In the early months of 2026. Heavy snowstorms put New York’s emergency system and the whole city to the test. In Brazil, a long run of severe heatwaves left cities across the country with temperatures above 40°C for days, including Rio, where the heat index reached 50°C in some favelas.

Although new institutions and technologies have emerged to deal with these emergencies, they sometimes will fall short and not enough to prevent deaths, displacements, and losses of every kind.

This dossier opened with dilemmas rather than answers: how much of an emergency system should be shared across hazards and how much built for specific ones, when to centralise coordination and when to distribute it, whether to invest in permanent institutions or assemble temporary ones. The cases show that no single answer holds across cities. The dilemmas of Section 2 are not problems to be solved once, they are choices a city makes and remakes as its risks change.

The stack approach makes those choices legible and actionable. As a diagnostic, it shows leaders which layers are well equipped, which are thin, and which components are missing or failing. It moves past "the city lacks capacity" as a general statement towards something specific: which layer is absent or misaligned, and why. Read this way, a vague sense of not being ready becomes a map of where the gaps sit. The stack does not tell a city whether to centralise or distribute, to build permanent agencies or temporary task forces; it lays out the functions, roles, standards, and infrastructure clearly enough that those choices can be made with eyes open, and revisited as conditions shift.

Its second use is harder to measure but matters more. Naming the layers gives a city a language to imagine arrangements it has not yet tried: a monitoring function carried by residents rather than sensors, a protocol that lets a utility and a health service act on the same trigger, a financial solution designed before the disaster rather than improvised after it. System reconfigurations are not only possible but desirable in this approach. Far from a finished model ready to implement, these are early thoughts on what it could look like, offered as a frame for cities to design with. We want as the next step to interact with teams from cities that wish to explore new arrangements for their institutions for emergencies.

The new structures may have prevented even greater impacts, but it will be vital to use the lessons learned to do better next time. Nearly 140 years after the blizzard and the drought, the hazards have changed and multiplied, but the underlying task has not: cities still have to organise themselves for the emergencies they can foresee and the ones they cannot. Our suggestion is that every city needs some version of the stack, less as a blueprint than as a shared language to guide design, collaboration, and practical work.

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