Smart Urban Resilience:

Enabling Citizen Action in Disaster Risk Reduction and Emergency Response

(ESRC/CONACyT ES/S006583/1)

Best Practice Review (Global and Mexico): Smart Cities and Digital Technologies in DRR

Working Paper 2; Work Package 1

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I. Introduction

The general objective of this document is to present the final research work that incorporates the literature review, the identification of national experiences, as well as global best practices, in terms of smart cities and digital technologies for Disaster Risk Reduction (DRR). The specific objectives are to examine the main debates around the use of technology in the face of disasters; to identify and make a brief description of the initiatives of this type that have been developed in Mexico, with special emphasis on Acapulco, Puebla, and Querétaro; as well as a review of the best global practices in the use of smart digital technologies in urban contexts.

The literature review has identified the existence of a 'damage approach', traditionally focused on addressing the effects of the disaster, which is considered a moment of 'rupture' with respect to normality. Recently, there has been a shift towards a 'prevention-focused approach', which emphasises the social, economic, or urban conditions prior to the disaster, which intensify its effects. The varying degrees of vulnerability of those who experience a disaster means that the effects are also experienced differently. A criticism of urban and smart disaster technologies is that they are still framed within the 'damage approach' despite discourse to the contrary.

Six smart technologies were identified that can be used for RDD: integrated platforms, Sensors, and Internet of Things (IoT), Crowdsourcing, Remote Sensing, Smartphone Apps, as well as Big Data Analytics. For Mexico, 8 initiatives were found for the first, 14 for the second, 2 for Crowdsourcing, 5 for the fifth, while only one was found for the sixth technology. Likewise, 25 successful global experiences were identified, which are presented in the third section of the document.

The paper is divided into four sections. The first section provides a review of the literature that relates technology and disasters, as well as the different positions on

the nature of this relationship. The second section presents a classification of the main urban and smart digital technologies, an explanation of how they work, the objectives they pursue, their main challenges, as well as some emblematic examples. The third section contains a compilation and ranking of the best global practices of this type that were identified. The fourth section replicates the same exercise as the previous one, but only for the Mexican case. Finally, the general conclusions of the document are presented.

II. Main Debates Linking Technology and Disasters

In the studies that relate technology to disasters, there are two theoretical debates that are worth taking up again. The first has to do with the way in which technology is conceptualised, as well as its role in public policies and interventions aimed at disaster risk reduction. In general, there is an optimistic view of the use of technology, which can occasionally even be naïve. It is seen as a means that invariably allows better decisions to be made, as well as helping to reduce loss of life, economic impacts and damage to property and infrastructure.

The second debate revolves around the way in which disasters and emergencies are defined, the relationship they have with technology, as well as the way in which the latter is materialised in concrete actions. For example, for Gaillard and Mercer (2013) there has been a crucial change in how disaster is conceptualised, as there has been a shift from a paradigm of hazard, focused on the event as a rupture, to another paradigm more focused on vulnerability, which emphasises the previous conditions of social inequality and spatial inequalities as determinants of the way in which disasters develop and are experienced.

The paradigm shift is clearly reflected in the Sendai Framework, which is the international mechanism that seeks to inform, shape, and regulate DRR policy worldwide. The Sendai Framework focuses on DRR, which makes it different from the Hyogo Framework, the latter of which aimed to reduce disaster losses. Specifically, Sendai seeks 'the substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of people, businesses and communities and countries.' (UNISDR, 2015, 12). The shift in focus is no small matter as it reflects a growing concern to intervene before disaster strikes. Basically, it is recognised that the impacts that materialise after the disaster are intimately related to the social, economic, urban, as well as infrastructure inequalities that existed previously.

The threat or harm approach normally assumes the need for centralised interventions that are designed and implemented in a top-down manner. However, it is important to consider that there is local knowledge or actions that can be extremely important in dealing with such situations. Although the Sendai Framework has promoted a vulnerability approach to disaster management, DRR, as well as emergency response, this conceptualisation is not directly translated into policy action at the local level. However, so far this seems to remain at a purely discursive level because ways to encourage, promote and empower local actions, technologies and stakeholders have not been developed (Aitsi-Selmi, Blanchard and Murray; 2016a).

Achieving mixed actions in which top-down approaches are combined with bottom-up community logics is not a purely technical challenge. There is a theoretical proposal that links theory with practice, by studying the roles of the set of stakeholders that exist between international institutions, whether governmental, private, and non-governmental, as well as local and community based. Gaillard and Mercer (2013) suggest a reconciliation between different forms of knowledge and action, integrating different scales and reconciling bottom-up and top-down approaches (94).

Gaillard and Mercer's (2013) approach has several implications that go beyond technology. This is because their questions concern the relationship between science, technology, and local action – in particular, the authors argue that even if local knowledge is increasingly recognised as having value and useful lessons for delivering DRR solutions, challenging the primacy of scientific knowledge, there is still a need to bring scientists and communities together when designing DRR policies and technologies.

This will imply a better dialogue between scientists, experts, communities, and other stakeholders, as this is where the gaps between the bottom-up and top-down approaches mentioned above can be bridged. The intersection between the two domains, that of expert knowledge and local knowledge, can potentially materialise

through various participatory practices, although they need to be complemented by institutional, financial as well as political changes if the role of the community is to be enhanced.

A concept that has recently gained prominence in the field of DRR has been that of resilience, which assumes that communities should be allowed to take charge of preparedness, prevention, and recovery on their own. This notion has recently gained traction as something positive, without necessarily developing a deeper reflection on its implications. Resilience often appears as a way of making communities responsible for their own safety and survival, without fully questioning the conditions under which resilience becomes a necessity.

Criticism of the concept of resilience argues that this idea marginalises populations that are already vulnerable, as well as reinforces deeply entrenched inequalities. Authors such as Duffield (2016) have argued that resilience, in its most simplistic versions, celebrates a logic of improvisation as a means to empower citizens. From a radical stance of self-reliance all responsibility remains on the side of those affected by humanitarian disasters, while experts maintain control from a distance. This situation implies that the presence of the State, and even of civil society, recedes in disaster-affected areas.

For other authors, it is yet another way of ensuring that the ‘status quo’ remains (Derickson, 2016). That is, vulnerable communities are asked to recover from repeated shocks that actually arise from deep and multidimensional inequalities. Moreover, resilience often means maintaining the conditions of the political, economic, or environmental system that caused the problems to be addressed in the first place, so that such phenomena are likely to end up perpetuating themselves indefinitely.

The situation is no different when looking specifically at digital technologies emerging in urban contexts for DRR. These types of initiatives start from engineering, computer science, as well as other related disciplines or fields, which often seek to

reduce the disaster caused by a physical event (Alcántara-Ayala and Oliver-Smith 2019). Again, these types of technologies fall within a damage/threat focused approach to disasters, from individual, only occasionally collective) responses that are functional in a moment of disruption. Previously existing spatial and social inequalities continue to be disregarded.

One of the objectives pursued by this type of technology is the improvement of the information available, as well as the communication flows. The lack of information may exist due to the non-existence of adequate channels, but also because those that exist are deficient. Some technologies dedicated to achieving this goal are drone-enabled mobile networks (Hayajneh et al. , 2016), social media, sensing devices, wireless networks, Internet of Things (IoT), among other computing architectures (Yang, Su, & Chen, 2017). For example, social media allow for greatly improved communication, the formation of online communities to discuss the disaster and recovery, and even to foster communication between volunteers, authorities, or the general public (Shankar 2008, Vos and Sullivan 2014, Park and Johnston 2017).

Another important goal is to learn more about disaster cultures and how people behave when disasters occur. The findings suggest that some digital technologies, particularly social media, are embedded in broader political, social, or spatial processes. This implies that variables such as income, education or age may influence the intensity, as well as the type of use that is made of them. Social media are also a thermometer that allows us to monitor day-to-day events, based on information provided by those affected. Interactions in digital media do not arise from scratch, but are affected by pre-existing social relationships, previous experiences, or the levels of trust that prevail in a given context (Williams et al., 2018).

Another objective is the collection, storage, and accurate use of data. With regard to data collection, it is important to note that it is not only about the people who first experience a disaster or the authorities or social organisations that are activated to respond to it. More broadly, it is about collecting data from the entire environment

through sensors, drones or databases of past events or disasters. In this context, human beings become one more technological tool, as they are the vehicles that carry, mobilise, and transfer the devices built for such purposes.

The trend of promoting crowdsourcing solutions for people to become sensors has been called: ‘citizen sensors’. These trends have been observed with optimism, as they enable mass crowdsourcing, as well as voluntary citizen sensing through mobile applications or specialised computer architectures. The assumption behind is that this enables more efficient interaction between different groups of people, including authorities, first responders or the people directly affected (Liu 2014, Ludwig et al.2017). The existence of ‘citizen sensors’ implies that people must possess a set of technological devices or add-ons with permanent access to the internet.

III. Digital and Smart Technology Initiatives to Cope with Disasters in Mexico

The objective of this section is to provide an overview of the current digital and smart urban technology landscape in Mexico, with a particular focus on the interface between digital technologies and DRR. It is divided into two sections. The first presents smart urban initiatives in general. It begins by comprehensively presenting initiatives based in Puebla, Querétaro, and Acapulco, to cover as many initiatives, projects, and policies as possible. While many of these are currently on hold or have been suspended due to financial and political changes and trends, they have left footprints both materially and as elements of a broader discourse on smart cities in Mexico. After providing this comprehensive list, we present a selection of smart city initiatives and smart city technology providers in other parts of Mexico. We include some of the major public projects and private companies selling different smart urban solutions across the country, ranging from city-wide interventions to localised technologies and projects.

The second section looks at digital technologies developed or designed explicitly for disaster and emergency preparedness, prevention, response, and recovery. These initiatives are not unique to the three cities on which the project focuses. Instead, we present a comprehensive view of the state across the country. Eight initiatives have been found. They range from earthquake monitoring to collaborative mapping, and have been developed by private, public, and civil society stakeholders, often working together. Some have emerged from local experiences and initiatives, while others are part of broader circuits of technology design, production, and development. While many of the initiatives we have encountered are natively digital (they began as digital enterprises), others have become so as older projects and organisations expand and change.

Basic information is included for each initiative, the scale at which they operate, a brief description, what their primary objective is, the main stakeholders and some possible contact details for some participants. In addition, we present a basic classification that works on two different levels. The first relates to the source of funding and the main stakeholder in the leadership, development and management of the project or initiative. Here we propose four categories: local government-led; urban development initiatives; private companies offering products and services; and civil society. The second relates to the type of technology they develop or use. These include crowdsourcing, digital mapping, remote sensing, and integrated platforms, among others, and are summarised in Table 1.

Table 1. Main Technologies and Their Definition

Technology	Definition
Integrated platforms	This category contemplates urban control panels (Kitchin, Maalsen and McArdle 2016) as well as control rooms (Luque-Ayala and Marvin 2016), and other technologies that integrate data and display it visually through monitors and other similar technologies.
Internet of Things and sensors	This includes sensor devices deployed in urban and non-urban spaces, such as sensors that enable the operation of early warning systems (Alcántara-Ayala and Oliver-Smith 2019). Also included are devices connected through the Internet of Things (IoT), which make it possible for them to monitor environments and provide data, but also to operate automatically or semi-automatically (Gabrys 2016).
Open Collaboration (Crowdsourcing)	Technologies that rely on the data user to build databases or to map disasters, as well as disaster response, are contemplated (Zook et al. 2010).
Remote Sensors	It considers the use of satellite sensors, aerial photography, which are different from other sensor technologies because they are not embedded in space or inside the monitored buildings.
Smartphone applications	Smartphone applications are interfaces that mediate and shape user interactions with various forms of disaster or emergency risk reduction responses. This technology is usually related to other technologies, such as remote sensor networks in the case of early warning systems, or to open collaborative mapping.
Big Data Analytics	As the data available to understand emergencies and disasters proliferates, whether through the existence of sensors, use of social media or remote sensors, big data analytics play an increasingly important central role in Mexico's digital and smart city initiatives. These analytics promise real-time identification of disasters more efficiently than other forms of monitoring (Earle, Bowden and Guy 2012).

Source: the authors, based on cited material.

It is important to note that social media play an important role in contexts of disasters and emergencies (Madianou, 2015; Ferris et al., 2016; Murthy and Gross, 2017).

This has also been found in Mexico, with commercial platforms such as Twitter, Facebook or WhatsApp being used at the time of a disaster or emergency, in organisations and institutions that are dedicated to these issues, in civil society and in government. However, no company has been identified that explicitly uses this information for disasters and emergencies in any of their phases in the Mexican context, and this is the reason why social media do not appear as a category in this document.

First, we summarise the initiatives in Querétaro, Puebla, and Acapulco. We found that a common feature in all cities is integrated platforms, more specifically control rooms. In the city of Querétaro, we identified the Ciudad Maderas project, which was originally proposed by a development company called Grupo ProHabitación. Instead of doing the development on its own, in 2011 the company invited the InteQsoft cluster, UCO, Grupo Mondragon, the Mexican American Hospital, as well as Hoteles Misión. The goal was to build 60,000 homes in Ciudad Maderas, with a projected population of 300,000 inhabitants, by the time the project was completed (originally for 2020 but was extended to 2025). Led by InteQsoft, the project was defined as a smart city, where sensors and the Internet of Things would enable smart devices to monitor urban flows, with the goal of making Ciudad Maderas more efficient and safer.

Also in Querétaro, the Secure Information and Analysis Centre (CISA) was identified as a state-level Control Room. It is connected to municipal control rooms, including those in the metropolitan area of Querétaro, as well as those in El Marqués, Corregidora and Huimilpan. The last three have already been built and the last one (in the city of Queretaro) is currently under construction. CISA was developed by the Spanish company GESAB. REDCIAQ is a monitoring initiative established in the city of Querétaro. Its goal is to map and report extreme rainfall using a network of sensors deployed throughout the city. It is led by the Faculty of Engineering of the Autonomous University of Querétaro.

For its part, CIDESI (Centre for Industrial Engineering and Design) has a microtechnology laboratory. There, engineers and researchers are developing sensor technologies for use in a wide range of industries, spaces or problems. This includes a project to install sensors in the city of Querétaro, which would be used to monitor pollution, rainfall, flooding, as well as other flows.

The Smart Puebla initiative was announced as a platform to transform the city into a smart city with a focus on social justice. It was launched as a platform to allow different stakeholders in the city to collaborate to find solutions to urban problems. Smart Puebla included the development of a smart phone app, free wireless internet access, a bike sharing scheme, as well as smart home developments (all of which were planned, but not built).

Finally, Acapulco's C4 is an integrated platform that connects video cameras, remote sensors, and a control room in the city of Acapulco. In 2016, Acapulco's C4 was under military control. In recent years there has been an attempt for the C4 to increase its coverage to include cameras in bars, avenues, but this has failed so far. In August 2019 it was announced that C4 would be substantially expanded and renamed C5. This would involve the purchase of new technology and a substantial investment of one hundred million Mexican pesos. The state government cancelled those plans in December 2019 due to their high costs.

Table 2. Smart City Initiatives in Querétaro, Puebla, and Acapulco

Name of the initiative	Place	Type	Main technologies used	Is it active?
Maderas City	Querétaro	Urban Development	Sensors and Internet of Things	Yes
CIAS	Querétaro	Run by the state government	Integrated platform	Yes
REDCIAQ	Querétaro	Public consortium	Sensors	Yes
CIDESI	Querétaro	Public - private consortium	Sensors	Yes
Smart City Puebla	Puebla (city level)	Urban Development	Smartphone application, Internet of Things, Sensors.	No

Smart Neighbourhood	Puebla (state level)	Urban Development	Internet of Things, sensors, crowdsourcing	No
C5	Puebla (state level)	Run by the state government	Integrated platform	Yes
C4	Acapulco	Run by the state government	Integrated platform	Yes

Source: the authors

Across Mexico, the picture is more varied. Several global companies offer solutions nationwide. At the same time, smaller Mexican companies are offering smart products to a growing market as more municipal and state governments adopt smart city discourses and develop projects and initiatives. These different governments are heavily involved in designing, building, and managing a variety of smart initiatives, including urban development projects, a variety of smartphone applications, and integrated platforms. The second subsection discusses these in more detail. We do not claim to be exhaustive. Instead, we showcase initiatives in Guadalajara, Mexico City and include companies operating across the country, given their prominent role in current smart city discourses, policies, and practices in Mexico.

Finally, most of these initiatives develop and use a variety of digital technologies. Some are developed by local governments and businesses themselves, while others are provided by global companies in public-private partnerships and projects. We summarise the data related to technology use and purpose in Table 3, and detail how public and private stakeholders are involved in the document itself.

Table 1Technologies and Frequency of Use Among the Selected Initiatives

Technology	Initiatives	Main uses
Integrated platforms	8	They are mainly used for security monitoring and their role in disasters and emergencies must be empirically analysed.
Internet of Things (IoT) and sensors	14	Most initiatives understand 'intelligence' as a mix of Internet of Things (IoT) that makes possible monitoring, continuous sensing of data in urban spaces, as well as inside buildings.
Remote Sensors	2	The two initiatives included that use remote sensors, such as satellites or drones, do so to monitor various flows in urban space.

Open Collaboration (Crowdsourcing)	2	Only two initiatives have been included in which open collaboration was included in the project design as a way to obtain information in a specific city. Although this is a consequence of the selection of the cases, it is still relevant to question how open collaboration applications and other forms of data tracking are or are not present in the Mexican context.
Smartphone applications	5	Many smart cities include the design of some smartphone applications. While a couple allow two-way communication and users provide data through them, most are unidirectional by design.

Source: the authors, based on cited material.

IV. Global Best Practices of Smart and Digital Technologies to Cope with Disasters

This section contains a version of smart city best practices with respect to disaster risk reduction and emergency response worldwide. Table 4 below indicates the systematisation of cases and stakeholders developed in this report with respect to smart city best practices in disaster risk reduction and emergency response. The cases and stakeholders are divided into groups with similar characteristics; while most of the cases and stakeholders are solely about smart cities, some others are national or international implementations with impact in urban contexts.

Table 4. Systematisation of Cases and Stakeholders

Category	Case or stakeholder?	Identification name	Danger addressed	DRR and ER (Emergency Response)?
Collaborative mapping	Case	Dar es Salaam, Tanzania	Floods	DRR
	Case	Kathmandu, Nepal	Earthquake	DRR + ER
	Case	Several cities in Indonesia	Floods	DRR + ER
	Case	#V19s in Mexico City	Earthquake	ER
Maps as information	Case	Safemap in South Korea	Multihazard	DRR + ER
	Case	RiskInfo in Sri Lanka	Multihazard	ER
Command and Control Centre	Case	COR in Rio de Janeiro	Multihazard	ER
Cities as a whole	Case	Hazur in Barcelona, Lisbon, and Bristol	Floods	DRR
	Case	Several cities in New Zealand	Multihazard	DRR + ER
Initiatives	Stakeholder	100 Resilient Cities	Multihazard	DRR + ER
	Stakeholder	World Bank + GFDRR	Multihazard	DRR + ER
	Stakeholder	Coastal Resilience	Sea level rise	DRR
Large organisations	Stakeholder	UNDRR	Multihazard	DRR + ER
	Stakeholder	Red Cross Red Crescent	Multihazard	DRR + ER
	Stakeholder	Resurgence	Multihazard	DRR
	Stakeholder	Facebook	Multihazard	ER

Technological stakeholders	Stakeholder	Google	Multihazard	ER
Map Stakeholders	Stakeholder	Esri	Multihazard	DRR + ER
	Stakeholder	Humanitarian OpenStreetMap Team	Multihazard	DRR + ER
	Stakeholder	Ushahidi	Multihazard	ER
	Stakeholder	Vizonomy	Floods	DRR + ER
Educational and research Centres	Stakeholder	Pacific Disaster Centre	Multihazard	DRR + ER
	Stakeholder	Urban Risk Lab	Multihazard	DRR + ER
	Stakeholder	ND-GAIN	Multihazard	DRR
Insurance networks	Stakeholder	Oasis	Multihazard	DRR

Source: Prepared by the authors based on the websites of each initiative.

a. Best Practices: Success Stories

1. Collaborative mapping

Dar Ramani Huria in Dar es Salaam, Tanzania

The Dar Ramani Huria project is a community mapping initiative with the intention of providing the authorities and citizens of Dar es Salaam with access to quality data while raising awareness of flood risks (Dar Ramani Huria, 2016; Ospina, 2018). The translation of Dar Ramani Huria from Swahili is Dar Mapa Abierto (Ospina, 2018). The city has problems with floods that prevent people from moving around, resulting in schools, hospitals, and businesses having to close (Ospina, 2018). However, the city of Dar es Salaam did not have quality maps of streets, buildings and landmarks to make decisions in the face of this problem (Ospina, 2018).

Dar Ramani Huria is a project that started in 2015 and is ongoing for 2019 (Uithol, Kateregga, Radford, & Sutton, 2015). It is an initiative implemented by the World Bank that is funded by the UK Department for International Development and is part of the Tanzania Urban Resilience Program (Dar Ramani Huria, 2016; Ospina, 2018; The World Bank, 2019b).

The following organisations are also involved in this project (Dar Ramani Huria, 2016; Ospina, 2018): 1) Dar es Salaam city authorities to facilitate communication with officials of the wards which is the main local administrative level (Urban Settlement Working Group, 2019); 2) Authorities of the councils (councils) in which the city of Dar es Salaam is divided; 3) National government of Tanzania through the Tanzania Open Data Initiative which aims to digitise maps of the country; 4) University of Dar es Salaam in partnership with the University of London; 5) Ardhi University which already has curricula that allows the efforts of this project to continue (Ospina, 2018); 6) Buni Innovation Hub for entrepreneurship of young talent programs; 7) Commission for Science and Technology (Costech) which is a parastatal that promotes research and use of technology; 8) Humanitarian OpenStreetMap Team; and 9) Tanzania Red Cross, United States and Denmark through the Zuia Mafuriko program.

The main intention of Dar Ramani Huria is to generate information in an Open Street Map, which is a free and open platform that allows building maps collaboratively (Ospina, 2018). The project has four phases (Dar Ramani Huria, 2016): i) collecting data from various sources; ii) digitising the information into an Open Street Map; iii) modelling scenarios; iv) sharing results for decision making. Data are collected from several sources: in the field through the OpenDataKit and OpenMapKit application, from geospatial open sources, with drones through OpenDroneMap, with a Garmin VIRb camera for street level views and with satellite information from Bing, Uav, Mapbox, Digital Globe Standard and Digital Globe Premium (Ospina, 2018).

The field mapping required training community members and students and always took into consideration an equal participation of women and men (Ospina, 2018). Since the project began, 950,000 buildings and 26,000 kilometres of roads have been mapped covering five to six million people (Dar Ramani Huria, 2016; Ospina, 2018; Uithol et al., 2015). Also, 960 people have been trained to map, of which 635 are from the community and 313 are students (The International Bank for Reconstruction and Development / The World Bank, 2018). One of the intentions of the project is that the networks of young people who map the city generate an

awareness of the risks that they end up socialising with family and friends (Ospina, 2018).

The project has a page that allows to contrast the before and after intervention; likewise, it has disaggregated information by ward and neighbourhood regarding mapping period, area, population and percentage of buildings at risk with recommendations for action (Dar Ramani Huria, 2016). Currently the project is in a phase that aims to use machine learning to monitor buildings under construction (The International Bank for Reconstruction and Development / The World Bank, 2018). It should be noted that the project was not always well accepted by all citizens; in particular, many people were afraid to share information for fear that the data would be used to demolish properties on informal land or as proof that they did not pay taxes (Ospina, 2018).

Kathmandu, Nepal

Several experiences of open and community mapping have been developed in various areas of Nepal, particularly in the Kathmandu metropolitan area. These mappings have made it possible to know the vulnerability of critical infrastructure, such as hospitals and educational centres, as well as the general situation of urban housing. Similarly, collaborative mapping experiences have raised awareness among the population about the importance of reducing risks and having better mechanisms to respond to emergencies.

The first initiative studied is the mapping of critical infrastructure. This project was called Open Cities Kathmandu and emerged in 2012 and intends to determine the vulnerability of educational and health buildings in the Kathmandu metropolitan area (Harvey, Eltinay, Barnes, Guerriero, & Caffa, 2017a; Kathmandu Living Labs, n/d-e; The World Bank & Humanitarian OpenStreetMap Team, 2014). The project has multiple stakeholders on board (Harvey et al., 2017a; Kathmandu Living Labs, s/f-e; The World Bank & Humanitarian OpenStreetMap Team, 2014). First, the Government of Nepal, which, in that year, had five main programmes for disaster

risk reduction and emergency response. One of them was to measure the vulnerability of schools and hospitals.

Another important stakeholder was the Department of Education: it led the risk measurement project and sent letters so that mappers could interact easily. International agencies also participated, such as the World Bank, which already had a critical infrastructure mapping initiative and contacted local stakeholders to carry out the project, as well as the GFDRR Open Cities Project. The participation of the National Society for Earthquake Technology (NSET) was identified, which advised with data modelling and performed quality measurements of the information collected. Finally, the Department of Geomatics and Engineering of Kathmandu University and Tribhuvan University were also present: they collaborated with volunteers for the mapping.

The project initially consisted of a core team of six full-time, salaried graduates from Kathmandu University, six interns from Kathmandu University, and 11 interns from Tribhuvan (The World Bank & Humanitarian OpenStreetMap Team, 2014). The Government of Nepal provided an incomplete list of schools and health facilities to begin locating the places of interest through snowballing (The World Bank & Humanitarian OpenStreetMap Team, 2014). Finally, the team trained government officials, grantees and community members to learn open mapping techniques in Open Street Map (The World Bank & Humanitarian OpenStreetMap Team, 2014).

This first collaborative mapping of health and education infrastructure involved 2,300 people in the first year (Harvey et al., 2017a). This experience allowed 10,000 buildings to be mapped, of which 2,256 were educational facilities and 350 were health facilities (Harvey et al., 2017a; The World Bank & Humanitarian OpenStreetMap Team, 2014).

Once the first mapping project was completed, the people involved were keen to keep these efforts going and to expand them further (The World Bank & Humanitarian OpenStreetMap Team, 2014). Therefore, in 2013, several of the

participants formed Kathmandu Living Labs to continue training communities in open mapping (The World Bank & Humanitarian OpenStreetMap Team, 2014). This organisation received funding from the U.S. Embassy and collaborated with the Nepalese government authorities (The World Bank & Humanitarian OpenStreetMap Team, 2014).

On April 25, 2015, a 7.8 magnitude earthquake killed 9 thousand people in Kathmandu, Nepal (Ushahidi, 2019a). At this time, there was 70-80% mapping of the affected area, but there was a need to know the current status of the situation (Sinha, 2015). Given this situation, Kathmandu Living Labs used Ushahidi's Quakemap platform to enable citizen reports that could be addressed by the authorities (Ushahidi, 2019a). This platform enabled 2,500 reports in one week that were directly addressed by the Nepal Army ('QuakeMap.org | Kathmandu Living Labs,' n.d.; Ushahidi, 2019a). Likewise, previous experiences with open and community mapping training have allowed for post-earthquake vulnerability measurement of buildings to aid reconstruction efforts (Kathmandu Living Labs, n.d.). They have already mapped 800,000 houses (Kathmandu Living Labs, n.d.a.).

Nepal already has one of the largest open and community mapping communities in the developing world (Kathmandu Living Labs, n/d-c). Also, national security discussions take this data into consideration for planning (Kathmandu Living Labs, n/d-b). The Prepare Pokhara – 2C Secondary Cities project intends to bring the experience of community and collaborative mapping and emergency reporting knowledge to more cities in Nepal (Kathmandu Living Labs, n/d-d). This project is a partnership of the municipal governments of Pokhara, the Nepalese Army, the Nepal Red Cross Society and Kathmandu Living Labs (Kathmandu Living Labs, n/d-d).

In 2011, the Nepalese and British Red Cross implemented the Earthquake Preparedness for Safer Communities (EPSC) programme (British Red Cross, 2019; International Federation of Red Cross and Red Crescent Societies, 2018b). The EPSC programme was intended to generate emergency preparedness measures (International Federation of Red Cross and Red Crescent Societies, 2018b). Two of

the actions they carried out consisted of the formation of committees that covered geographical areas that would allow them to direct these processes and the emergency response; likewise, they designed communication strategies to give warnings in these events (International Federation of Red Cross and Red Crescent Societies, 2018b).

The 2015 earthquake left several lessons (British Red Cross & Nepal Red Cross Society, 2017; International Federation of Red Cross and Red Crescent Societies, 2018b): i) the geospatial working approach is not entirely suitable for the urban context of Nepal because of poor social cohesion, heterogeneity and difficulty in connecting with community members; ii) communication mechanisms were not fully catered for by people during an emergency; iii) vulnerable groups were not supported by local authorities.

In this context, the Strenghtening Urban Resilience and Engagement (SURE) programme emerges with the intention of increasing disaster risk awareness among four vulnerable groups in seven municipalities in Nepal (Kathmandu, Bhaktapur, Mhadhapur-Thimi, Godavari, Bhudhnilkantha, Dhangadhi and Pokhara-Leknath) (British Red Cross & Nepal Red Cross Society, 2017; International Federation of Red Cross and Red Crescent Societies, 2018b).

This program starts from a Multihazard approach, emphasises participatory mechanisms and, unlike the EPSC program, is not from a geospatial perspective, but from a networking perspective (British Red Cross & Nepal Red Cross Society, 2017; International Federation of Red Cross and Red Crescent Societies, 2018b). The networking perspective was chosen because in the 2015 earthquake people dealt with the emergency through relationships they already had before the hazard and not with committees covering different areas of a population (International Federation of Red Cross and Red Crescent Societies, 2018b). The premise is that taking into consideration the relationships already existing in a community is more effective in planning risk reduction measures (International Federation of Red Cross and Red Crescent Societies, 2018b).

Thus, the SURE program categorises the population into different groups to locate those who may be more vulnerable to a situation of danger (elderly people, people with disabilities, children, single mothers, for example) (British Red Cross & Nepal Red Cross Society, 2017; International Federation of Red Cross and Red Crescent Societies, 2018b). They then identify the types of community these groups generate according to places they frequent, interests, culture, daily practices, similar experiences of resistance or displacement, or virtual and digital communities (British Red Cross &Nepal Red Cross Society, 2017; International Federation of Red Cross and Red Crescent Societies, 2018b). Finally, it forms groups according to vulnerability and the types of community they generate to elect representatives with whom to lead action (International Federation of Red Cross and Red Crescent Societies, 2018b).

Likewise, one of the main intentions of the programme is to understand which messages and which media are most effective in getting people to change behaviours in the event of an emergency (International Federation of Red Cross and Red Crescent Societies, 2018b). The interest in understanding the effectiveness of messages stems from the experience of the 2015 earthquake in which few people heeded the messages sent through various media (International Federation of Red Cross and Red Crescent Societies, 2018b).

Finally, this program has also emphasised the importance of connecting vulnerable populations with local governments (International Federation of Red Cross and Red Crescent Societies, 2018b). The consideration is that these groups hardly receive support in emergency situations as there is no prior relationship of knowledge.

Cities of Indonesia

Peta Bencana was the first real-time flood mapping in a city in the world (Holderness & Turpin, 2016). This initiative that emerged in Jakarta, Indonesia has complemented hydraulic sensors with people's reports so that authorities can better act in an emergency (PetaBencana.id, n.d.; Urban Settlement Working Group,

2019). It has also been accompanied by new initiatives to identify vulnerabilities with similar techniques. This project began in 2013 and has increasingly begun to expand to more cities and new sources of information (‘PetaBencana.id’, n/d-a).

Jakarta has a density of 14,000 people per square kilometre and is home to 30 million human beings (Harvey et al., 2017a; Urban Settlement Working Group, 2019). About 40% of its land area is below water level, making it a risk area for potential flooding from four of the thirteen rivers that flow through the city (Human and Machine, n.d.; Urban Settlement Working Group, 2019). Between the months of October and March, the rainy season begins (International Federation of Red Cross and Red Crescent Societies, 2018b) that come to produce floods in which a large number of people use social media to communicate; however, the information became confusing to deal with emergencies (Human and Machine, n/d).

Under the motto ‘humans are the best sensor’, the organisation Peta Bencana and the MIT Urban Risk Lab developed an application to integrate all sources of information along with hydraulic sensors in a single platform (Harvey et al., 2017a; Human and Machine, n.d.). This platform, which uses CogniCity software, has partnerships with various stakeholders to make geo-referenced reports through social media contact so that authorities can be aware of what actions are needed (Harvey et al., 2017a; PetBencana.id, n.d.).

Reporting on social media happens in the following way (Harvey et al., 2017a). First, it is necessary to write a post or a message with the words *banjir* or flood and to throw the Peta Bencana account in a social media. Subsequently, a bot sends an automatic response with a link to geo-reference the report. The link leads to the PetaBencana.id platform where there are user-friendly formats for the user to report the severity of a flood. These partnerships have been developed with Twitter and Telegram, as well as Z Alert, Pasangmata and QPlue (local apps). Flood reports and information are visualised on a map on a web platform (‘PetaBencana.id’, s/f-a).

Among the stakeholders involved are the Badan Nasional Penanggulangan Bencana (BNPB) or Indonesian National Disaster Management Board: this authority already officially uses the Peta Bencana application to deal with emergencies and invites citizens to make their reports by this means (Harvey et al., 2017a). Also, the MIT Urban Risk Lab: developing the platform together with Peta Bencana. The participating civil society organisations were the Pacific Disaster Centre, with the provision of monitoring information and the development of event simulation software; the Humanitarian OpenStreetMap Team (HOT), with training for the use of the platform; as well as Peta Bencana, a civil society organisation that designs the platform. USAID, which accompanies BNPB and provides financial support, Australia AID with financial support, as well as the Australian National Data Service also participated.

Given the good experience of using technology to cope with emergencies, in 2017, BNPB, Peta Bencana, MIT and the Pacific Disaster Centre again conducted a project together in the city of Jakarta (Harvey et al., 2017a; Urban Settlement Working Group, 2019). This project consisted of four phases: i) importing existing open-source databases of roads and buildings; ii) remotely mapping buildings and roads; iii) collecting detailed floor-level information through the OpenMapKit application (Urban Settlement Working Group, 2019); iv) finally, this information feeds the InaWare platform that allows recognising vulnerable locations and buildings. Previously, the Indonesian government used the Pacific Disaster Centre's DisasterAWARE software, but they developed their own software to integrate information from other organisations in one place (Humanitarian OpenStreetMap Team, n/f-a). Subsequently, BNPB, the Pacific Disaster Centre and the Australian government developed InaSAFE – a QGIS plugin – which is a FOSS (free and open source software) for anyone to import event data and community features to simulate hazard events (Pranantyo, Fadmastuti, & Chandra, 2015).

In the same vein, the latter project has been replicated with much greater participation in other cities in Indonesia. In Semarang, the Peta Kota project was

implemented by HOT with the support of Peta Bencana, the Pacific Disaster Centre and MIT (Humanitarian OpenStreetMap Team, s/f-b) together with a local urban artist collective called Hysteria Colectiff (International Federation of Red Cross and Red Crescent Societies, 2017). Similarly, The Nature Conservancy participated through the Coastal Resilience program (Coastal Resilience, 2018e). The Peta Kota program, which in Indonesian means map of the city, is intended to train community members to build maps (Harvey et al., 2017a).

The training starts with places of interest such as mosques and schools to build up an overview of the city; subsequently, the community starts mapping buildings (Harvey et al., 2017a). The Peta Kota project has managed to map fifty thousand buildings on an Open Street Map as well as 176 thousand square kilometres with the help of 26 thousand people (Harvey et al., 2017a; Humanitarian OpenStreetMap Team, n/d-b). Finally, this information is used to identify green or blue infrastructure opportunities (Coastal Resilience, 2018e).

The collaborative mapping information, early warning system and the Peta Bencana platform have enabled Indonesian authorities and the community to act in emergencies and reduce disaster risks. Authorities and the community can monitor, respond and provide emergency information to around 50 million people (PetBencana.id, n.d.).

These experiences have provided a basis for action that can be replicated in other places, as they have proven to be effective (Urban Settlement Working Group, 2019). Likewise, collaborative mapping and emergency reports have increased awareness of risks and strengthened community participation in the resolution of public problems (Urban Settlement Working Group, 2019). All this information has been collected to generate a risk atlas, as well as evacuation routes in case of emergency (Urban Settlement Working Group, 2019). The Peta Bencana platform already enables care in the cities of Jakarta, Semarang, Surabaya, and Bandung.

- **2. Maps to inform**

Safemap in South Korea

Safemap is a first safety map portal with a web and mobile application that receives information from various local agencies on a variety of topics, including disaster safety (Harvey et al., 2017a; Korea Safety Map, n.d.). The app came out in 2014 and has 2.68 million users (Harvey et al., 2017a; Ministry of the Interior and Safety, n/d). The app is only available in Korean and features a choice of eight categories of interest, including disaster safety (Korea Safety Map, n/d). The application can generate thematic and customised maps according to the user's preferences; it can also display indices that facilitate the collection of information and its comparison between areas (Korea Safety Map, undated).

Within the disaster safety category, there is the possibility to select data on: i) current disaster information, including landslide, flood, and insurance risk; ii) risk history for fire, collapse, landslide, and earthquake; iii) safety measures and contact details of national agencies. The Ministry of Public Security promotes quiz competitions to familiarise people with the use of the app (The Korea Bizwire, 2018).

RiskInfo in Sri Lanka

Similar to the experience in Nepal, Sri Lankan authorities – together with international stakeholders and civil society organisations – have conducted collaborative vulnerability identification mapping projects that localise risks and raise awareness of hazards. These efforts have finally been integrated together with governmental information into a platform that provides all the information on risks and allows for emergency reporting. Inspired by similar experiences, various stakeholders in Sri Lanka aimed to map critical assets, such as schools and hospitals, as well as road infrastructure and residential buildings (The World Bank & Humanitarian OpenStreetMap Team, 2014).

The stakeholders involved were (The World Bank & Humanitarian OpenStreetMap Team, 2014): National Government, which provided credibility and legitimacy for stakeholders to interact with local governments. They also provided staff and offices. The agencies involved were the Disaster Management Centre; the Census Department; the Survey Department; the Manmunai North Division Secretariat of the local government; the Humanitarian OpenStreetMap Team (HOT), with equipment training, remote support for satellite imagery mapping and software corroboration; University of Colombo; University of Peradeniya; Sri Lanka Institute of Technology; University of Moratuwa; University of Sri Jayewardenepura; as well as Easter University.

The project was formed by a core team of technical experts with GIS degrees who were trained by HOT (The World Bank & Humanitarian OpenStreetMap Team, 2014). This team was complemented by people from the community, national government staff and students from the schools for field assessments (The World Bank & Humanitarian OpenStreetMap Team, 2014). This project did not consider information from previous maps due to their low quality; therefore, it was necessary to collect data from satellite images, sites of interest, streets, street names and landmarks (The World Bank & Humanitarian OpenStreetMap Team, 2014). Subsequently, the complementary team assessed buildings in the city for number of floors, type of uses, materials and type of construction (The World Bank & HumanitarianOpenStreetMap Team, 2014). The data from this team was evaluated through sampling to find anomalies and thus ensure its quality (The World Bank & Humanitarian OpenStreetMap Team, 2014).

The Sri Lanka Disaster Management Centre launched the Risk Info portal on 21 December 2017 as a national platform with information on disaster risk (Risk Info, 2018). Since 2012, data from various organisations and initiatives were already available, but were not used in an integrated way (Risk Info, 2018). This platform contains information on buildings, roads, power lines and hazard probability maps (Risk Info, 2018). The platform operates in three languages (Sinhala, Tamil and

English) and has data on floods, tsunamis, landslides, cyclones and droughts, among others (Risk Info, n.d.).

- **3. Command and Control Centres**

COR in Rio de Janeiro, Brazil

The Rio Operations Centre, Centro de Operações Preifetura do Rio de Janeiro, (COR) integrates information from thirty municipal and state agencies in one place to visualise and improve service delivery in the city of Rio de Janeiro (Harvey et al., 2017a). The main intention of the project was to anticipate solutions, warn of risks and take urgent action in the face of floods and landslides ('COR - Centro de operações Rio', n.d.). However, the project has evolved into a governance scheme for the mayor of the city as it allows him/her to have a perspective of what is happening in real time in the city and thus to make better decisions on various issues (Frey, 2014). This case is relevant because it is the first of its kind, because it is the most ambitious command and control centre in the world, and because it has been an inspiration for many other cities (Frey, 2014; Harvey et al., 2017a).

On April 5, 2010, 68 people died in Rio de Janeiro as a result of flooding and landslides in different parts of the city (Harvey et al., 2017a;Schreiner, 2016). In that year, Rio had a population of 5.94 million, with a population density of 5,377 people per square kilometre (Urban Sustainability Exchange, n/d), of which 1.47 million lived in some vulnerable area (Urban Sustainability Exchange, n/d).

The initiative arose as an idea of the administration of the city of Rio de Janeiro. It was created through a municipal decree with the aim of increasing resilience (Urban Sustainability Exchange, n.d.). Faced with the floods and landslides that caused the death of 68 people, the Municipal Information and Technology Company and the

Pereira Passos Municipal Urban Planning Institute conceived the idea of a technological platform that would integrate information from different agencies (Urban Sustainability Exchange, n/d). The first intention was to have information from all phases of disaster management: prediction, mitigation, preparedness and feedback for the future (Harvey et al., 2017a).

Thus, Mayor Eduardo Paes turned to IBM, which had the Deep Thunder Weather Monitoring project, which measured the weather around the world, to forecast heavy rains 48 hours in advance in order to take precautionary measures (Lindsay & Lindsay, 2010; Lyle & Harrison, 2014). The mayor also went to IBM for the work of this company in experiences of smart cities: i) in Madrid with the command and control Centre with police, ambulance and fire information (Centre for Public Impact, n/d); ii) in New York with the police information Centre (Urban Sustainability Exchange, n/d); iii) and in Stockholm and London with a system of traffic quotas to avoid congestion (Lindsay & Lindsay, 2010; Singer, 2012).

The project was mostly carried out by IBM (Singer, 2012), although other organisations also participated. Samsung was in charge of installing the screens in the control room, Bilfinger installed the 15 thousand sensors in the city, Cisco implemented the telepresence system that connects with the mayor's residence, Itautec built the computer network used by employees, Google geo-referenced locations in the municipality, and the telecommunications companies OI and TIM made the connection for data transmission (Singer, 2012; Urban Sustainability Exchange, n/d).

The project cost $14 million (Frey, 2014; Scuotto, Ferraris, & Bresciani, 2016; Singer, 2012), of which $8.9 million was for the building (Urban Sustainability Exchange, n.d.). The COR began operating on December 31, 2010 and was part of the city's planning for the 2016 Olympic Games and the 2014 Men's World Cup ('COR - Centro de operações Rio', n.d.; Schreiner, 2016).

The COR is a command and control Centre of the Rio de Janeiro City Hall (Prefeitura da Cidade do Rio de Janeiro) that integrates information from thirty municipal and state agencies (Harvey et al., 2017a). It also collects information from fifteen thousand sensors, GPS systems in city vehicles, satellite images, and social media reports on natural hazards, public transportation, and safety (Harvey et al., 2017a). There are currently 500 people working on this project, it has 800 of its own cameras and has access to another 700 from private stakeholders ('COR - Centro de operações Rio', n.d.).

This Centre is located in a 1,800 square metre building four stories high located in the Cidade Nova neighbourhood (Scuotto et al., 2016) The COR has different rooms (Urban Sustainability Exchange, n/d): the control room is the heart of the project and has two hundred controllers in three shifts that monitor the city's cameras on screens totalling 65 square metres; the crisis room that serves for emergency cases and is connected to the mayor's residence; the press room to give alerts to the population and that maintains a constant relationship with the press; the ideas room where the Pensa group works by searching, analysing and evaluating correlations on data obtained over time with the intention of identifying patterns to suggest public policies. The Pensa group is inspired by the Geek Squad in New York (Schreiner, 2016). Likewise, this Centre concentrates the 1746 hot line that serves for citizens to be attended on problems, complaints and requests (Urban Sustainability Exchange, n/d).

The COR operates twenty-four hours a day, seven days a week ('COR - Centro de operações Rio', n.d.). This Centre allows anticipating solutions, alerting about risks and taking urgent measures in the face of natural dangers, but also regarding traffic, daily life safety, as well as major events ('COR - Centro de operações Rio', n.d.). It has a page that shows the current state of the city, which can be normal, attention or crisis ('COR - Centro de operações Rio', n.d.; Sistema Alerta Rio da Prefeitura do Rio de Janeiro, n.d.).

The main page shows a dynamic map of the current weather, as well as the weather forecast so that authorities and citizens can identify areas at risk ('COR - Centro de operações Rio', n.d.). This dynamic map has different colours that alert about the danger in the coming hours ('COR - Centro de operações Rio', n.d.). The COR also has profiles on Twitter, Facebook, Instagram and Youtube to maintain communication with citizens and issues three daily bulletins with information on traffic, weather conditions and relevant events of the day ('COR - Centro de operações Rio', n.d.).

The general activities carried out by the COR can be summarised under three broad headings: risk prevention and management, by attempting to save lives, predict hazards and monitor the weather; routine operations related to safety and traffic; and activities related to major events such as the Olympic Games (Urban Sustainability Exchange, n.d.).

The COR collaborates with the following agencies: Alerta Rio (weather monitoring); CVL Pensa (technology); CET-RIO (traffic); COMLURB (urban cleaning); Conservation (maintenance); Civil Defence (disasters); GEORIO (hillsides); Municipal Guard (order); IPLANRIO (technology); RIO ÁGUAS (drainage and water metres); RIOLUZ (public lighting); SMTR (transportation); SMH (housing); SMAC (environment); SMS (health); SMDS (social development); SMDS/CRV (shelter regulation); CEDAE (sewage and water); CEG (gas); LAMSA (roads); LIGHT (electricity); METRÔ (transport); SUPERVIA (transport); as well as the CICC, composed of the PMERJ, PCERJ, Fire Department, SAMU, Civil Defence and PRF.

The COR, in cases of crisis, has reached 500 thousand users on its portal, has 653 thousand followers on Twitter, 421 thousand followers on Facebook and 88 thousand on Instagram (Schreiner, 2016). The COR has made it possible to integrate information from previous city efforts to reduce disasters. Since 1966, the GeoRio agency has collected information from telemetric stations (currently thirty-three) and a radar in Sumaré to know the state of rainfall (Scuotto et al., 2016; Sistema Alerta Rio da Prefeitura do Rio de Janeiro, n.d.). Similarly, GeoRio

investigates landslide risk areas to take preventive actions (Prefeitura da Cidade do Rio de Janeiro, 2009). This information was already presented on a warning page, as well as in an application (Sistema Alerta Rio da Prefeitura do Rio de Janeiro, n.d.), but the COR has made it possible to integrate it with additional information for better decision-making.

The COR has partnerships with different mobility platforms ('COR - Centro de operações Rio', n.d.). It has agreements so that the notifications sent by users in some applications are also a source of real-time information for the Centre; for example, with Waze for vehicular traffic, as well as with Moovit for public transport alerts. In the case of Waze, it receives fifty thousand reports daily. It also has an agreement with Twitter to send notifications to previously registered users through Twitter Alert. It also collaborates with Trafi, an application for planning trips in the city, and with Lvrit, an application that provides routes for people with reduced mobility ('COR - Centro de operações Rio', n.d.).

One of the criticisms of this Centre is that it is still very focused on the response part, while leaving aside the preventive part and the use of information for planning (Gaffney & Robertson, 2018; Singer, 2012). On the other hand, the Pensa group has already severed its relationship with IBM, although this organisation continues to present the whole case as publicity (Gaffney & Robertson, 2018).

- **4. Multi-city initiatives**

Hazur in Barcelona, Lisbon, and Bristol

Hazur is the software of the start-up Opticits that allows combining data from various sources to simulate risk scenarios and identify interdependencies, cascade effects and critical infrastructure points in the event of a hazard (Harvey et al., 2017a). This development analyses different cities from the conception of cities as a whole, that

is, as a complex system of interconnected systems (Opticits, s/f-a). This application has been used in more than thirty cities, including Barcelona (Opticits, s/f-c). Currently, this software has received funding from the European Union, within the Resccue initiative, so that it can be widely used in more European cities (Opticits, s/f-b).

In July 2007, the city of Barcelona suffered an electrical blackout as a result of a severe drought in the city's reservoirs and an overload in the commuter rail system due to the construction of a high-speed train (Malgrat et al., 2017). Faced with the electricity blackout, the Barcelona City Council, the Chemical Institute of Sarrià (IQS) and the School of Engineers of the City of Paris (EIVP) carried out an applied research project with the intention of guaranteeing the continuity of urban services in the event of an impact (Chelleri, 2018; Opticits, s/f-c). At the end of that project, in 2013, several of the people involved decided to incubate this initiative to formalise it and created Opticits as the first company to create online tools for resilience plans (Opticits, n/d-c). Their main product, Hazur, implemented a pilot measurement test in the Forum -Besòs area in 2014 (Chelleri, 2018; Malgrat et al., 2017).

Opticits offers its Hazur software as a service, certified training, advisory services and urban infrastructure management (Global Innovation Exchange, 2019; Opticits, n.d.c.). Opticits intends to establish urban resilience standards for small and medium-sized cities based on its software that can also be compatible with early warning systems (Global Innovation Exchange, 2019). Hazur is a tool that allows decision-makers to be informed about the interconnection of services in a city (Opticits, n/d-c).

Since 2016, Hazur has been funded as part of the Resccue project by the European Union under the Horizon 2020 initiative (Opticits, n.d.). The Resccue project (RESilience to cope with Climate Change in Urban arEas) will run for four years and aims to enhance the resilience capacities of cities to anticipate, prepare, respond and recover from impacts (Resccue, n.d.). In the Resccue project, Hazur is leading

the assessment of the state of services and infrastructure in the three cities (Malgrat et al., 2017).

The cities chosen for this project are Barcelona (because of its experience in recent years in resilience issues), as well as Lisbon (which has suffered from flooding in electrical substations that ended up cutting traffic lights and telecommunications) and Bristol (where tidal surges have closed several streets in the city) (Velasco et al., 2018).

Several cities in New Zealand

New Zealand has expressed its intention to be a leader in disaster risk reduction from a whole-of-society perspective that understands the interaction of the systems that make up a community (McElroy, 2015). Wellington and Christchurch, two of its most populous cities, have made significant efforts in this regard following their experiences of earthquakes. Between 2010 and 2011, 375 thousand people lived in Christchurch, New Zealand (McMurren, Verthulst, & Young, 2016). During this period there were two major earthquakes. The first, on September 4, 2010, was non-fatal (McMurren et al., 2016). However, the second, on February 22, 2011, with a magnitude 6.3 left 175 people dead (Harvey et al., 2017a; Landry, Webster, Wylie, & Robinson, n/d).

Initially, the city council and emergency organisations developed a web application, based on Ushahidi's experience in the 2010 Haiti earthquake, to track the state of emergency conditions and report back to the military (Harvey et al., 2017a; McMurren et al., 2016). The information was collected collaboratively and had 700 thousand hits in 48 hours (McMurren et al., 2016). With concerns about a new earthquake, the city developed apps for people to identify if an area was in any danger zone; this page had a total of 5 million visits, of which 3.3. were in the first day (McMurren et al., 2016). Subsequently, the app began to give information about what could happen in some location in the face of future earthquakes and what

needed to be considered for new construction in the city, which provided reassurance to people after the earthquake (McMurren et al., 2016).

For its part, Christchurch faced a reconstruction that involved repairing 80% of the underground infrastructure in the downtown area; likewise, twelve hundred buildings needed to be demolished and built on that land (McMurren et al., 2016). With the city's extensive use of apps to inform itself about risks, actions, and status after the earthquake, the Forward Works Viewer was developed that allowed visualisation of all projects under construction to plan and view impacts over time (Harvey et al., 2017a). This application enabled intelligent retrieval that allowed those building to observe construction plans in an area to avoid delays or obstructions (McMurren et al., 2016). The Forward Works Viewer saved around NZ$4 million (approximately US$2.65 million).

Wellington suffered an earthquake – called Kaikoura – in November 2016 (100 Resilient Cities, 2019b). As a consequence of this event, several neighbourhoods in the city were left without water and power services due to damage to the primary or central supply networks (100 Resilient Cities, 2019a). Following this experience, the Wellington City Council implemented a series of policies to make the water and energy services network redundant to avoid the city being left without services during the event or for several weeks in the event that the main network required repairs (100 Resilient Cities, 2019b).

A first measure was related to energy. For this, they designed virtual power plants that aggregate energy generation from different sources (100 Resilient Cities, 2019b). The intention was to avoid reliance on centralised infrastructure so that there would be no cascading effects (100 Resilient Cities, 2019b). An alternative way to generate energy was with solar panels on different homes; but this program recognised that hard infrastructure (in this case, panels) was not enough, but soft infrastructure (networks of people) was also needed (100 Resilient Cities, 2019b). Therefore, the city council gave subsidies to households interested in participating in this program in exchange for contacting neighbours and informing them that the

benefited household would be a place of refuge in case of power shortages (100 Resilient Cities, 2019b). In addition to the panels, the government provided packages that included a tank with oil, water, and outdoor light connectors (100 Resilient Cities, 2019b).

Another measure was related to pipelines and water service provision. This program began in 2017, after the earthquake, with an investment of US$8.25 million (100 Resilient Cities, 2019a). The intention was to decentralise the water supply network in case of emergency through 22 stations strategically placed near parks or places of community affluence that do not depend on the main network and that are even redundant to it (100 Resilient Cities, 2019a). These stations are activated by the community itself and the government has developed communication campaigns to prepare communities for their use (100 Resilient Cities, 2019a). This system aims to cover 80% of the city's consumers for 30 days to supply 80% of their water needs (Cardno, n.d.).

Both Wellington and Christchurch have been affected by earthquakes and have also made efforts to more accurately monitor the impact of these events (100 Resilient Cities, 2019e). For one, the city of Wellington plans to measure the impact of an earthquake on a third of the city's commercial buildings (100 Resilient Cities, 2019e). To do so, it will use 400 accelerometers and will enter into a partnership with the University of Auckland and the University of Tokyo with the intention of making more informed decisions regarding evacuation and post-earthquake assessment processes (100 Resilient Cities, 2019e). While the city of Wellington already has accelerometers, this initiative would make it the city with the greatest coverage (Cann, 2017).

On the other hand, the Christchurch City Council has developed, together with Canterburry Seismic Instruments Ltd, the EQRNet platform within the Smart Christchurch portal that integrates measurements from 100 sensors across the city that monitor the variability of motion following an earthquake (Smart Christchurch, 2019b). This system is accompanied by evacuation guidance, building guidance,

emergency response guidance and summaries for the general public based on sensor measurements (Smart Christchurch, 2019b). In addition, the Smart Christchurch portal has a map of the city with a heat layer indicating the general and particular intensity of earthquakes since the sensors were installed (Smart Christchurch, 2019a).

b. Multilateral and global stakeholders

100 Resilient Cities

100 Resilient Cities is an initiative of The Rockefeller Foundation that aims to build a network of cities, organisations and experts working on urban resilience issues. 100 Resilient Cities – the largest climate change adaptation initiative to emerge in the United States – intends to work from a holistic and collaborative perspective that learns from best practices elsewhere (100 Resilient Cities, 2018b; Smart Cities News Team, 2019).

The 100 Resilient Cities initiative was devised by The Rockefeller Foundation to celebrate the centenary of the Rockefeller Foundation (100 Resilient Cities, 2019c). In 2005-2007, Judith Roding, president of Rockefeller, invited Raj Shan to spearhead international development efforts (Flavelle, 2019). By 2013, the convening began with the intention of building a network of cities, organisations, and expert individuals to foster urban resilience through sharing best practices and generating problem solutions together (100 Resilient Cities, 2019c, 2019c).

The city selection process begins with an open call for applications, in which 100 Resilient Cities receives applications that it analyses based on criteria of innovation and interest in building resilience plans (100 Resilient Cities, 2019c). This initiative

began its work in December 2013 with 32 cities; in 2014, 25 more joined; and by May 2016, a network of 100 cities was achieved (100 Resilient Cities, 2019c).

After the selection of the cities, the initiative works within 6 to 9 months with them to generate a resilience roadmap based on the characteristics, capacities and previous actions of the community (100 Resilient Cities, 2019c). Although this initiative is not focused on DRR, it does consider it as one of the components that make up urban resilience (100 Resilient Cities, 2019d, 2019c). This initiative does not rely on large infrastructure works for mitigation because it considers that they are often very costly and damage the environment (100 Resilient Cities, 2019d).

One of the great offers of being a city that belongs to this initiative is the payment of the salary of a person who will serve as the resilience officer in a city (Herd & Murithi, 2016). This person should have strategic, integrated and coherent thinking (Herd & Murithi, 2016). Their role is to be able to connect the different agencies and stakeholders relevant to these issues to join collaborative efforts (100 Resilient Cities, 2019c).

Another great offer of this initiative is the possibility to be part of different networks. Firstly, there is the communication with experts on these issues who provide logistical guidance for the integration of resilience plans together with the resilience officer (100 Resilient Cities, 2018b). Second, 100 Resilient Cities has generated a platform for partners to connect with organisations specialised in providing solutions to resilience issues (100 Resilient Cities, 2018b). Finally, 100 Resilient Cities connects different cities to share best practices and learn from successful experiences in cities with similar characteristics (100 Resilient Cities, 2018b).

152 projects and alternatives have emerged based on the initiative, with 14,000 people from the communities already connected and working on their implementation (100 Resilient Cities, 2018a). In addition, 80 holistic resilience strategies have been generated and the salaries of 80 city resilience officers have been paid (100 Resilient Cities, 2018a; Armstrong, 2017). Within the participating

members and organisations, pro-bono services amounting to $230 million have been provided (100 Resilient Cities, 2018a). (Armstrong, 2017). In total, this initiative has reported 4 thousand actions and initiatives that have supported $25 billion in external funding (100 Resilient Cities, 2019d).

World Bank + GFDRR

The World Bank undertakes several efforts in resilience and disaster risk reduction. The most significant is the Global Facility for Disaster Reduction and Recovery (GFDRR) in which it manages a partnership with other countries around the world and international organisations. In this partnership, there are efforts to pilot projects that use collaborative mapping, one-page information integration and scenario modelling to increase awareness and make better decisions about disaster risk reduction.

The World Bank considers itself a leader in financial and technical support for disaster risk measurement (The World Bank, 2019a). In 2018, the World Bank granted $5.3 billion for disaster risk management (The World Bank, 2019a). GFDRR was established in 2006 as a partnership managed by the World Bank and supported by 37 countries and 11 international organisations (Global Facility for Disaster and Reduction, 2018). There are also donors, observers and guests in this initiative (Global Facility for Disaster and Reduction, 2018). Currently, GFDRR works with 400 local, regional, national and international partners by providing knowledge, money or technical assistance for disaster risk reduction projects based on the Sendai Framework (Global Facility for Disaster Reduction and Recovery, 2019g). The GFDRR has built partnerships with similarly themed projects such as the Rockefeller 100 Resilient Cities, Cities Alliance and Medellin Collaboration (Global Facility for Disaster Reduction and Recovery, 2019f).

Projects in different parts of the world are divided into different areas of connection (Global Facility for Disaster Reduction and Recovery, 2019c). The Innovation Lab division develops tools to collect, share and understand risks at low cost (Global

Facility for Disaster Reduction and Recovery, 2019e). The Innovation Lab is divided into three major clusters. The first is the Open Data for Resilience Initiative (Open DRI) which began in 2011 and aims to apply global knowledge in data to natural hazards (Understanding Risk, 2019). This initiative has sought to maintain dialogue with governments to implement pilot projects consisting of collaborative mappings whose information is integrated into GeoNode -an open source system for managing geospatial content- (GeoNode, 2012; Open Data for Resilience Initiative, 2015; Understanding Risk, 2019).

It has also sought to leverage InaSafe software – developed by the Government of Indonesia and Australia – to model scenarios in the face of natural hazards to calculate impacts and make better preventative decisions (Understanding Risk, 2019). Open DRI has started a project with 11 sub-Saharan cities – called Open Cities Africa – to map buildings and roads with the intention of identifying risks to make better decisions, while increasing community awareness of danger (Open Cities Africa, n.d.).

The second group is Understanding Risks which is a group of experts who study and try to understand risks (Understanding Risk, 2019). Finally, the third group is Disruptive Technologies. Currently, a large project deals with disruptive technologies (3D printing, drones, artificial intelligence and Internet of Things) to develop pilot projects through the Innovation Lab (Global Facility for Disaster Reduction and Recovery, 2019a).

GFDRR and the World Bank – directly – launched the Resilient Cities program in June 2017 with the intention of empowering cities to invest in resilience issues (The World Bank, 2019c). Currently, this program has supported 45 cities around the world (The World Bank, 2019c). In addition, it developed a rapid diagnostic methodology to identify city risks from a holistic and comprehensive perspective that takes 2-6 months to complete (The World Bank, 2019c).

Another area of connection is Hydromet, which has developed hydrometeorological services and early warning systems to assist countries with monitoring, forecasting and data analysis (Global Facility for Disaster Reduction and Recovery, 2019d). GFDRR also has financial protection projects that are not intended to be lenders of money in the event of an emergency, but rather to create incentives for governments to be proactive and better manage their risks (Global Facility for Disaster Reduction and Recovery, 2019b). Finally, other areas of GDRR work include community resilience, climate change resilience, recovery, a global safe schools programme and gender issues (Global Facility for Disaster Reduction and Recovery, 2019c).

Coastal Resilience

Coastal Resilience is a network of stakeholders who identify, through maps, vulnerabilities to sea level rise and flooding and then suggest mitigation spaces based on green or blue infrastructure. Coastal Resilience is an initiative formed by a network of practitioners that maps coastal vulnerability and aims to understand what the role of nature is in reducing flood risk (Coastal Resilience, 2018c). They have developed a four-step resilience approach (Coastal Resilience, 2018c): i) measuring hazard risk and community vulnerability; ii) identifying nature-based solutions; iii) conservation and restoration actions; iv) measuring the effectiveness of actions to reduce flood risk.

This program is focused on measuring risks from sea level rise, rainfall, and flooding (Harvey et al., 2017a). This program has already been implemented in 100 communities in the United States, Mexico, Central America, and the Caribbean (Coastal Resilience, 2018c; Harvey et al., 2017a). The initiative is led by The Nature Conservancy: this organisation has over 60 years of experience in green or blue infrastructure-based conservation and restoration (Coastal Resilience, 2018a). The Nature Conservancy is a global non-profit organisation focused on environmental protection that was born in the United States in 1951 (The Nature Conservancy, 2019). It is made up of 1 million members, including 400 scientists from 72 countries

on 6 continents (The Nature Conservancy, 2019). They have managed to protect 1 million hectares of land (The Nature Conservancy, 2019).

As a leader of the initiative, The Nature Conservancy relies on Coastal Resilience to conduct spatial planning to measure hazards and identify nature-based solutions (Harvey et al., 2017a). In different projects, it has collaborated with (Coastal Resilience, 2018a): United Nations University, The National Oceanic and Atmospheric Administration, U.S. Geological Survey, The Natural Capital Project, Association of State Floodplain Managers, University of California at Santa Cruz, University of Southern Mississippi, Esri, The Alliance for Development Works, International Federation of the Red Cross, as well as the Global Disaster Preparedness Centre.

Coastal Resilience offers several services. Among them, the Flood and Sea Rise App to observe areas that would be affected by flooding due to rain or rising sea levels. It also has the Future Habitat App that shows where the coast would move due to water movements. The latter app was developed particularly by The Nature Conservancy and the University of Southern Mississippi, and has already been used in Old Saybrook, Connecticut to identify and communicate to the community which areas will be affected by marsh encroachment and thus prevent with parcels of open space that will help for future wetlands (Coastal Resilience, 2018d).

The most referenced program is the At a Water's Edge program in Grenville, Grenada in which the Coastal Resilience approach was applied with the intention of carrying out disaster mitigation activities (Harvey et al., 2017a). Derived from this experience, a web platform was developed in which it is possible to visualise this effort (Coastal Resilience, n.d.). This platform, among other things, allows visualising on a map the percentage and total number of people at risk of flooding, in poverty and with some type of vulnerability; it also allows observing how much infrastructure could be affected, what type of critical infrastructure is in that place and what facilities there are to carry out emergency work. Coastal Resilience currently has a

partnership with Microsoft and Esri to begin using artificial intelligence to identify green or blue infrastructure opportunities (Coastal Resilience, 2018b).

Red Cross

National Red Cross and Red Crescent Societies are stakeholders in different DRR initiatives and projects. They currently have 13.7 million volunteers, which has enabled them to mobilise communities for DRR efforts (International Federation of Red Cross and Red Crescent Societies, 2019a). While the emphasis of this organisation or organisations is not on smart urbanism, they have collaborated on several initiatives with this perspective.

Since its 2006-2010 Agenda, the International Federation of Red Cross and Red Crescent Societies (IFRC) has considered DRR as a priority activity and pursues three main strategies in the communities where it collaborates on this issue ('The IFRC's Approach to Disaster Risk Reduction', 2019): i) strengthening the preparedness and capacities of communities to better respond to emergencies; ii) promoting activities to mitigate the effects of hazards; and iii) protecting development projects. In total, IFRC invested CHF 207 million in DRR projects in 160 countries benefiting 52 million people (International Federation of Red Cross and Red Crescent Societies, 2018a).

The IFRC has a platform where it communicates all the emergency response actions it is collaborating on. On this platform they indicate what they are doing, how much money they need and present information about what is happening on interactive maps. For each case it is possible to get an overview, see graphs, get alerts, and find contacts to provide help.

In addition, the IFRC, through its Global Preparedness Centre, offers three apps for DRR (International Federation of Red Cross and Red Crescent Societies, 2018a): i) the Universial App Program that serves to increase disaster awareness; ii) First Aid App that assists first responders in an emergency; and iii) Hazard App that provides

information on hazards. These apps were downloaded more than 5 million times in 90 countries during 2018 (International Federation of Red Cross and Red Crescent Societies, 2018a).

United Nations Office for Disaster Risk Reduction (UNDRR)

The UNDRR is an organisation that was preceded by previous efforts within the United Nations. In 1989, the International Decade for Natural Disaster Reduction was launched within the United Nations system with the aim of raising awareness on this issue (UN Office for Disaster Risk Reduction, 2019c). Subsequently, in the year 1999, the General Assembly, through resolution 56/195, urged to facilitate the International Strategy for Disaster Reduction through UNISDR as a focal point for coordinating disaster reduction strategies (UN Office for Disaster Risk Reduction, 2019c). The UNISDR was based on the Yokohama Framework (UN Office for Disaster Risk Reduction, 2019c). With the entry of the Sendai Framework, the UNISDR becomes the UNDRR to coordinate work from the new perspective.

Through a multi-stakeholder coordination approach, the UNDRR runs several campaigns at the international level, such as the Safe Schools and Hospitals initiative, risk reduction awards and recognitions, and the International DRR Day (UN Office for Disaster Risk Reduction, 2019b). It has also launched the Making Cities Resilient campaign, which includes 10 essential points to help cities become more resilient, as well as publications and technology tools to accelerate these efforts (UN Office for Disaster Risk Reduction, 2019a).

In its information work, the UNDRR publishes an annual global DRR measurement report, has an information platform and documents on prevention, has developed DRR terminology guides, integrates disaster statistics, and conducts publications and events related to the Sendai Framework (UN Office for Disaster Risk Reduction, 2019c).

Resurgence

Resurgence is a global technology and design company that specialises in climate risk data, modelling and communication (Resurgence, 2019e). While Resurgence is not a large organisation like the Red Cross or UNDRR, it does work closely with large organisations on different projects, making it an important stakeholder that manages to connect on high-impact projects despite its moderate size.

The company's most important project is Daraja, in which it is collaborating with UKAid to improve hydro-meteorological data in Dar es Salaam, Tanzania, and Nairobi, Kenya (Resurgence, 2019e, 2019b). This program consists of infrastructure processes to measure climate, as well as research on how people access information that is accompanied by simplification and visualisation adjustment processes with the authorities reporting this data (Resurgence, 2019b, 2019c). This project began in 2015 and will end in 2021 and represents an investment of £35 million (Development Tracker, 2019).

Resurgence has also worked to systematise cities' resilience efforts through open data (Resurgence, 2019e). In these projects Resurgence has collaborated with GFDRR through the Making Cities Resilient Campaign (Resurgence, 2019e): i) With the development of the Open Data Infrastructure for City Resilience document that contains 25 examples of cities using open data for resilience cases (Resurgence, 2019d); ii) With the Disaster Resilience Scorecard for Cities that facilitates 4,300 cities to report their resilience progress and is based on the Sendai Framework (Resurgence, 2019a).

Facebook

Facebook has a division – Crisis Response – specialised in developing security tools for natural disasters, terrorist attacks or any threat to life (Statt, 2017). The efforts are focused on responding to emergencies and have partnerships with different

organisations such as UNICEF, the International Federation of Red Cross and Red Crescent and the World Food Program (Statt, 2017).

It is Facebook's main tool for emergency response and allows to notify or search contacts to find out if a person is safe after a dangerous event (Statt, 2017). This tool is accompanied by important or viral news, photos, and videos about the phenomenon in question (Statt, 2017). While this idea is not original to Facebook, as eBay had tried something similar, Mark Zuckerberg's organisation has a competitive advantage because of the extensive network and use of its application (Cheney, 2018). The idea came after a 72-hour hackathon that ended in October 2014 on Mark Zuckerberg's desk (Metz, 2016). This project was quickly implemented and was launched in November 2014 for first use with Typhoon Ruby in the Philippines, although the first experience of extensive use was in the 2015 Nepal earthquake (Metz, 2016; Statt, 2017).

Initially, the process of activating the tools was manual by Facebook staff. However, following an incorrect activation in Thailand, as well as criticism of Western bias for activating it in the ISIS attacks in Paris in 2015, but not in Beirut and Baghdad which suffered similar events, Facebook decided to automate the activation of the tools through algorithms (Metz, 2016; Statt, 2017).

The process consists of a cross-check that begins with monitoring news stories – as well as information posts from security departments – which is confirmed by another algorithm that identifies whether people are talking about the event (Metz, 2016). Subsequently, Facebook sends a notification to users in the area and asks them if they want to report that they are safe; finally, Facebook asks if people want to send safety confirmation requests to their contacts (Metz, 2016). In this way, Facebook performs the activation by means of cross-confirmation algorithms that end up being corroborated by people who experience an event (Metz, 2016).

The first experience of automatic activation of this tool occurred in Orlando, Florida, in the mass shooting at the Pulse gay nightclub (Metz, 2016). Safety Check was

activated 11 minutes after the shooting occurred, at 3:47 a.m. (Metz, 2016). This automated tool has subsequently been used for natural hazards or impacts. This tool was launched in November 2015 and aims to coordinate disaster relief (Statt, 2017). It also has options to make donations to organisations that collaborate in responding to the emergency such as the International (Statt, 2017).

This Facebook function aggregates data from its application and visualises it through different types of maps so that organisations can respond to emergencies. This tool is not open, as it is reserved for use by organisations such as UNICEF, the International Federation of Red Cross and Red Crescent Societies and the World Food Program (Jackman, 2017). Of the different types of maps that can be visualised are those of population density, movement before, during and after the event, which is compared with historical Facebook statistics to recognise patterns of movement (Jackman, 2017). Disaster Map was launched in June 2017 and its first major application was for that year's floods in Peru (Jackman, 2017).

Google

Google's mission is to assist with crisis response by providing critical information that is relevant, credible, and in real time (Google, n/d-b). To this end, Google partners with various national security organisations, as well as emergency response agencies such as the Red Cross and FEMA in the United States (Google, n/d-b). This feature is activated by Google staff manually or on a case-by-case basis and works for the search engine and map applications when the user searches for information about the event or location affected (Google, n/d-b). When searching for information or locations, SOS Alerts provides information that depends on the user's location: if the user is close to the location, it provides emergency information such as phone numbers and government information; if the user is far away, it provides contacts for donations (Google, n/d-d).

Person Finder is a website that allows people to post or search for the status of people affected by an event (Google, n/d-c). It is based on the experience of people who

made the same effort on their websites for Hurricane Katrina in 2005; however, the widespread use and familiarity of people with Google has made its use more powerful (Google, n/d-c). The first major experience of this feature was in January 2010 in the Haiti earthquake and is also activated on a case-by-case basis by Google staff (Google, n/d-c). All information is deleted after a few months after the event to avoid outdated information (Google, n/d-c). It is a Google application that integrates emergency information through data from updated satellite imagery, as well as information provided by authorities or organisations with agreement on flooding, evacuations and places to receive asylum (Google, n/a).

Esri

Esri is the company behind ArcGis – a geographic information system GIS – and has carried out projects with several cities to reduce risks through green and blue infrastructure and has developed programs to deal with emergencies (Harvey et al., 2017a). Esri is focused on three types of consulting. The first is disaster preparedness with risk analysis, project prioritisation, and hazard awareness raising (Esri, n/d-b). The solutions it offers consist of data organisation, flood planning, and citizen engagement (Esri, n/d-b).

The second type of service Esri also offers is disaster response software using GIS technology that can be used for different hazards (Esri, n/a). Esri provides software for monitoring and analysing the work of any authority or organisation, as well as data from its Living Atlas that contains imagery, boundaries, socio-demographic, infrastructure, and environmental data about the entire world (Esri, n.d.a.). It also has specialised programs for brief emergency response status and visualisation for information communication (Esri, s/f-a). Esri has been involved in the emergency response work for Hurricane Harvey in Texas and Hurricane Maria in Puerto Rico (Esri, 2017).

Finally, Esri also provides resilience consulting with monitors that allow tracking the progress of the actions carried out (Esri, n/f-b). ArcGis is also a stakeholder involved

in the Rockefeller Foundation's 100 Resilient Cities initiative that has generated an international network of stakeholders, cities and organisations interested in promoting resilience in the urban context. Hurricane Joaquin in 2015 damaged 160,000 homes and killed 9 people (Esri, n/d-c). Richland County was one of the hardest hit despite requesting regulation for events that are likely to happen every hundred years; however, this hurricane is considered a once-in-a-thousand-year event (Esri, n/d-c).

In light of the damage caused by the hurricane, county authorities conducted land use analyses to prioritise opportunities for green areas as a measure to reduce the risk of future impacts (Harvey et al., 2017a). These measurements were conducted using ArcGis software and platforms such as the Living Atlas of the Planet, which, according to its creators, is the world's leading collection of geographic information (Esri, n/dec; Harvey et al., 2017a). This research project lasted six months and identified four priority areas as green infrastructure (Esri, n/d-c).

Humanitarian OpenStreetMap Team (HOT)

HOT is a team of trainers and technologists who help communities generate collaborative maps in formats compatible with other platforms that allow them to model hazard scenarios to reduce risks. These types of activities have also helped communities increase risk awareness and increase their capacity to respond. HOT provides coaching, training and connection with local groups to develop collaborative ground-level mapping skills that are accompanied by expert complementary satellite imagery or drone imagery from open platforms such as those developed by Digital Globe since 2015 (Digital Globe, 2019; Humanitarian OpenStreetMap Team, n.d.f.). The information is then fed into an OpenStreetMap and can be further used on platforms such as InaSAFE to model hazard scenarios and take measures to reduce risks (Humanitarian OpenStreetMap Team, n/d-e).

HOT has contributed to projects in which 177 thousand people have participated in mapping (Humanitarian OpenStreetMap Team, n/d-c). In these projects they have

managed to map 41 million buildings and 1 million kilometres of roads (Humanitarian OpenStreetMap Team, s/f-c). The year 2018 has been the year with the most support from HOT for disaster relief as it collaborated in 24 events around the world (Humanitarian OpenStreetMap Team, n/d-d).

Ushahidi

Ushahidi is a social enterprise that offers different services and tools to integrate information (from collaborative reports) to improve responses and decision making. Its tools have been used for several emergencies and has established itself as one of the most relevant stakeholders for emergency response. Ushahidi is a leading social enterprise in Africa working from Kenya, although it has a global team and works remotely all over the world (Ushahidi, 2019b).

This company divides its activities into three main areas (Ushahidi, 2019d): i) information collection, through various sources (SMS, email, social media, satellite images); ii) information management, through filters and workflows that allow visualising the status of a phenomenon; iii) data analysis, through configurable maps and graphs for better decision making. Likewise, Ushahidi also offers the opportunity to send automatic alerts in case of emergency (Ushahidi, 2019d). Ushahidi has received financial support and formed networks with: CISCO, Rockefeller Foundation, USA-AID, Google.org and Omidyar Network (Ushahidi, 2019b, 2019a).

Ushahidi started as an idea of 4 technologists who created a blog on WordPress that allowed them to observe dots on a map containing reports of violence in Kenya after the 2008 elections (Ushahidi, 2019b, 2019a). The intention of this platform was to give voice to people who were overlooked in other media to improve emergency response capacity (Ushahidi, 2019b). Ushahidi managed to map 40 thousand reports in those elections (Ushahidi, 2019a). The case of crisis mapping in the 2010 Haiti earthquake is the first major experience of collaborative mapping and is considered to be the work that set the tone for a number of subsequent emergency care developments (Ushahidi, 2019c).

After the earthquake of January 12, 2010, given the lack of information on platforms such as Google Maps, several people around the world began to create a collaborative map on Open Street Map through satellite images provided by the World Bank, as well as other open platforms, to address the information crisis that was experienced (Meier, 2012). Another group of people began to identify on these maps information on emergency reports obtained by SMS, social media, email, radio and television (Morrow, Mock, Papendieck, & Kocmich, n/d). Also, a third group supported with the translation of reports that were in Creole (Haitian Creole) (Meier, 2012). Later, Ushahidi took his experience in Kenya and designed a free and open platform to use the information obtained collaboratively and to analyse it live and interactively (Norheim-Hagtun & Meier, 2010).

Following these earthquakes, as well as after the floods in Pakistan, Ushahidi built the V2 Platform as a free tool that integrates reports from various sources to coordinate responses and share information in an emergency (Ushahidi, 2019f). This tool was used in Typhoon Haiyan (Yolanda) in the Philippines, as well as for the provision of humanitarian aid in Somalia by various non-governmental organisations (Ushahidi, 2019f). By 2012, Ushahidi started to become a social enterprise with an ecosystem of services and software related to data, maps, and reporting (Ushahidi, 2019a). In 2013, Ushahidi joins the 100 Resilient Cities initiative to continue to expand its work as a reference in the face of hazard cases (Ushahidi, 2019a).

By 2015, it updates its core reporting integration platform and launches the V3 Platform (Ushahidi, 2019a). Also, in this year, it collaborated in the Nepal earthquake with Kathmandu Living Labs organisation in 2015 to generate a reporting map that was followed by the authorities to provide aid and care (Ushahidi, 2019e). This experience is also one of the great experiences of report integration because of the previous collaborative mapping experiences and because of the authorities' prioritised use of these experiences.

Ushahidi tools have had 150 thousand developments in 160 countries, 31% of which have been used for humanitarian and crisis response (Doran, 2018). Ushahidi currently employs 30 experts in 10 countries around the world and its tools have been translated into 40 languages (Ushahidi, 2019a).

Vizonomy

Vizonomy is a data science, web-based visualisation, and online mapping company based in Washington, D.C. that provides tools to visualise risks, monitor in real time, and interpret satellite or drone imagery (Vizonomy, n/d-b). It is a tool designed for cities to assess economic losses in the face of sea level rise scenarios (Vizonomy, 2018b). This software takes the Flood Insurance Rate Maps (FEMA) vulnerability curves as a basis and visualises them in a user-friendly design platform (Vizonomy, 2018b). This software has already been implemented in 16 cities (Vizonomy, 2018a).

The Vizonomy software allows the visualisation of maps with 70 risk maps in a user-friendly platform in a dynamic way (UN Office for Disaster Risk Reduction, n.d.b.; Vizonomy, n.d.a.). Vizonomy also makes it possible to integrate monitoring with real-time climate flaps (UN Office for Disaster Risk Reduction, n.d.a.). In addition to the information provided by Esri from the U.S. Government, the user can import local data to supplement the maps (Vizonomy, n.d.a.). The intent of this program is to increase the public awareness of planners, emergency managers, and sustainability issues in cities of all sizes (Vizonomy, n.d.a.).

The most significant example of Asterra use is the Washington, DC flood risk portal that was launched in September 2018 (Vizonomy, s/f-a). Vizonomy has also collaborated with the US cities of Long Beach, Annapolis and Alameda (Vizonomy, s/f-a). Vizonomy recognises that it is not only technology that is important for risk reduction, but also effective communication. For this reason, they collaborated with the World Bank and Resurgence to develop an open data and risk communication framework for decision makers (Vizonomy, 2018a).

Pacific Disaster Centre

The Pacific Disaster Centre (PDC) is a research Centre that provides technology-based services to different stakeholders to address disasters. Among its services is a risk measurement methodology, as well as early warning monitoring and the largest collection of verified geospatial data in the world. PDC emerged in the aftermath of the 1991 Iniki Hurricane in Hawaii as a research Centre managed by the University of Hawaii (Pacific Disaster Centre, 2019a). This research Centre works with different agencies, world governments and non-governmental organisations by providing technology and applications to cope with disasters (Pacific Disaster Centre, 2019a).

PDC offers two major solutions for disaster risk reduction. The first is a measure of risk and vulnerability that takes into consideration three dimensions that it integrates into an index (Pacific Disaster Centre, 2019d, 2019b): i) exposure of people, property and systems; ii) economic, information, water access, health and environmental vulnerability; iii) lack of capacity to cope with emergencies from an environmental, economic, infrastructure and governance perspective.

The second solution it offers is the Disaster AWARE Risk Intelligence Platform that provides risk information and analytical tools to measure disasters (Pacific Disaster Centre, 2019d). On the one hand, this platform is the most powerful monitoring accompanied by multihazard early warning in the world (Pacific Disaster Centre, 2019c). On the other hand, this platform enables better decision making by containing the largest collection of verified geospatial data, including: real-time incidents, historical natural hazard data, predictive models, demographic and socioeconomic data, maps, and satellite imagery (Pacific Disaster Centre, 2019c).

MIT Urban Risk Lab

The MIT Urban Risk Lab is an interdisciplinary organisation of researchers and designers who develop methodologies, prototypes and technologies to reduce risk

and prepare cities and regions (Urban Risk Lab, n.d.a.). Its signature project has been a geolocation portal for emergency reporting and, recently, it has developed a prototype for resilient infrastructure. The Urban Risk Lab collaborated with Peta Bencana, USAID and the Indonesian government in the project of geolocation of citizen reports in emergencies in the city of Jakarta to improve communication with rescue authorities in the floods that affect this city (Urban Risk Lab, n/d-c). In 2017, 300 thousand people used this portal, which has already been expanded to 3 more cities in this country (Urban Risk Lab, n/d-c).

This same idea of geo-referencing reports so that authorities can intervene has also been implemented by Urban Risk Lab in Chennai, India in which they achieved 111,808 visits in one day to this portal in the floods of November 2015 (Urban Risk Lab, n/d-c). They have also developed projects for Broward County, Florida, as well as for Kumamoto, Japan (Urban Risk Lab, n/d-c).

Following its involvement in several emergencies, the Urban Risk Lab has placed emphasis on developing a prototype of resilient public infrastructure that is resistant to disasters (Urban Risk Lab, n.d.b.). After a hazard event, people in the community require information and energy that is often not available in their homes, so they turn to public places to contact others and gather necessities (Urban Risk Lab, n/d-b). This type of infrastructure fills this gap, and a prototype is being implemented in the city of Portland, USA, in collaboration with Portland General Electric and Portland State University.

ND-Gain

In April 2013, the Global Adaptation Institute moved to the University of Notre Dame in Washington, DC and began developing the ND-GAIN (Notre Dame Global Adaptation Index) (University of Notre Dame, 2019b, 2019a). The ND-GAIN is a program that is part of an interdisciplinary climate change research within the university itself, called the Notre Dame Environmental Change Initiative (University of Notre Dame, 2019b). The ND-GAIN measures 45 indicators over a 20-year time

horizon for 181 countries around the world (University of Notre Dame, 2019b). The intention of this index is to know how adapted countries are and to measure their capacities to cope with climate change (Harvey, Eltinay, Barnes, Guerriero, & Caffa, 2017b).

Within ND-GAIN, the intention has now begun to realise this same index but for cities of the world (University of Notre Dame, 2018). This city index, which plans to be an interactive database, is funded by the Kresge Foundation and led by the ND-GAIN team (University of Notre Dame, 2018). This index to cities is in its first phase and plans to measure 278 U.S. cities with populations over 100,000 (University of Notre Dame, 2018, 2019).

Oasis

Oasis is a consortium of open-source products that provide risk and catastrophe (mainly flood) measurement information that is accepted by the financial market for access to insurance (Harvey et al., 2017a). Oasis is a European consortium of insurance, reinsurance, climate modelling companies, research institutions and governments that emerged in 2012 with the intention of providing catastrophe models, software and tools to measure disaster risks (Oasis, 2016). It currently has 44 insurance company members and 60 associate members (Oasis, 2016).

Oasis is composed of five modules or work teams (Oasis, 2016): i) climate, which stochastically generates extreme climates for the model; ii) hydrological, which provides data on rainfall, droughts and water management; iii) risk, which forecasts damages in locations after a catastrophe; iv) adaptation, which provides hydrological and extreme weather tools; and v) visualisation, which generates the graphical interface of its programs. Its main product is the Oasis Loss Modelling Framework (OLMF), which is a tool for modelling catastrophes and analysing insurance prices (Oasis, 2016). It is built with open source, allows importing data for robustness and provides a user-friendly interface (Oasis, 2016). Currently, it has already been used

by 15 insurance providers who have developed 80 models by 2018 (Oasis Loss Modelling Framework, 2019).

It started with an interest in being the tool used to insure catastrophes on the Danube River, with an emphasis on the city of Budapest (Oasis, 2016). During this phase the OLMF was developed as a framework for model development worldwide. Oasis received funding from the Horizon 2020 project and EIT Climate-KIC of the European Union to further develop and refine their models in Budapest and the European Union (Oasis, 2019c). Also, in this project they have tried to improve the communication tools of their services (Oasis, 2019c). The European Union has funded with 4.8 million euros (Oasis, 2019b). One of the intentions of this project is to extend the OLMF to develop a model that can be used as a widely used catastrophe modelling and insurance pricing tool in the European Union (Oasis, 2016).

Furthermore, this project intends to deepen the analysis on the Danube River and start modelling multihazard and multihazard scenarios (Oasis, 2016). This initiative, Future Danube, is a GIS system that allows to analyse and overlay layers, and has been co-designed by Oasis and companies that will use this software (Generali, Uniqua, Allianz, The German Insurance Association and RISKCONSULT) (Oasis, 2019d) (Oasis, 2019d). Public sectors such as the Municipality of Budapest and the water and sewerage system of Budapest are also involved in this project (Oasis, 2019d). The ultimate goal of this consortium is to license their software so that they can sustainably stay in the market (Oasis, 2016).

V. Conclusions

There is a paradigm shift around DRR that increasingly focuses on prevention, vulnerability, as well as all the preconditions that can exacerbate the effects of a disaster. This is clearly reflected in the Sendai Framework, which seeks the substantial reduction of disaster risk and losses in lives, livelihoods, and health and in the economic, physical, social, cultural, and environmental assets of people, businesses and communities and countries (UNISDR, 2015, 12). However, despite the objectives that are set out in this document some authors have claimed that this has remained at a purely discursive level (Aitsi-Selmi, Blanchard and Murray; 2016a).

Technologies now in everyday use for DRD such as embedded platforms, the Internet of Things (IoT), Sensors, Crowdsourcing, Remote Sensing, Smart Phone Apps, as well as Big Data Analytics, are quite functional to address the immediate effects of a disaster but have not been used so far to modify pre-existing conditions of inequality. Still, these technologies have great potential to understand and impact these conditions, but so far, they have not been used intensively to do so.

In fact, one of the criticisms of the concept of resilience, which has been one of the most widely used recently, is that the technologies that are used to address the effects of the disaster usually operate at a distance, maintaining and even intensifying the inequalities that existed prior to the disaster. In fact, for some authors, this idea is one more way to ensure that the 'status quo' remains (Derickson, 2016). That is, vulnerable communities are asked to recover from repeated shocks that actually arise from deep or multidimensional inequalities.

However, technology does not necessarily have to be limited to mitigating the effects of a disaster. For example, sensors or IoT can be used to make diagnoses, analyse structural differences in buildings before disasters, and identify differences in risks

by urban areas. In the same sense, some crowdsourcing applications, as well as integrated platforms, allow to collect strategic information about locations, information flows, or physical flows of people, which also allow to diagnose risks in advance.

This work has identified that this type of technology is expanding in Mexico. The 30 projects identified show that initiatives are being developed that can be strengthened, modified, and implemented to better address this type of situation. Despite this, they are still focused almost entirely on the ‘damage approach’, which limits their ability to solve the structural problems associated with disasters. This is not a situation that is exclusive to the Mexican case, as the same is true of the 25 global experiences identified.

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Appendix 1. Summary tables of experiences with digital/smart technologies in Queretaro, Acapulco and Puebla [IN SPANISH]

Table 4. QUERETARO: Ciudad Maderas

Ciudad Maderas / Smart City Querétaro	
Tipo de iniciativa	Desarrollo Urbano
Escala y sitio de la iniciativa	Ciudad – Querétaro
Principales actores	Gobierno de Querétaro InteQsoft (Un clúster de tecnologías digitales inteligentes en Querétaro) Grupo ProHabitación (Desarrollador inmobiliario) La Universidad Contemporánea (UCO) – Universidad Mondragón Hospital México Americano Hoteles Misión
Objetivo principal	Desarrollar una ciudad Inteligente en un nuevo desarrollo inmobiliario en las afueras de Querétaro
Tecnologías usadas o desarrolladas	Internet de las cosas y sensores
Descripción	El proyecto Ciudad Maderas fue originalmente propuesto por una compañía desarrolladora llamada Grupo ProHabitación. En lugar de hacer el desarrollo por su propia cuenta, en 2011 la compañía invitó al clúster InteQsoft, UCO, Grupo Mondragón, el Hospital Mexicano Americano, así como los hoteles Misión. El objetivo era construir 60 mil casas en Ciudad Maderas, con una población proyectada de 300,000 habitantes, para cuando el proyecto fuera concluido (originalmente para 2020 pero fue extendido para 2025). Lidereado por InteQsoft el proyecto se definió como una ciudad inteligente, donde los sensores e internet de las cosas, posibilitarían que algunos dispositivos inteligentes para que estuvieran monitoreando los flujos urbanos, con el objetivo de hacer de Ciudad Maderas más eficiente y segura.
Contacto	Jorge Buitrón Arriola – Director de TI Mobile y Presidente del Consejo Nacional de Clústeres de TI Juan Carlos Coronado Mata – Director de InteQsoft Maximino Matus Ruiz – Académico
Más información	Reporte hecho por Maximino Matus Ruiz y Rodrigo Ramírez Autrán sobre Ciudad Maderas: https://infotec.repositorioinstitucional.mx/jspui/bitstream/1027/97/1/8.pdf Reporte de Deloitte sobre Smart Cities en Mexico: https://www2.deloitte.com/content/dam/Deloitte/mx/Documents/public-sector/Ciudades-inteligentes.pdf

Table 5. QUERETARO: CIAS

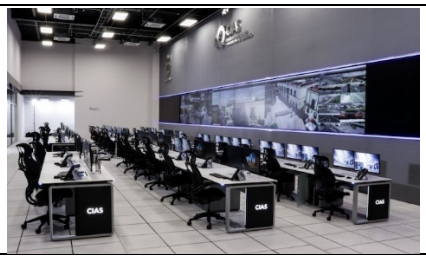
CIAS Querétaro	
Tipo de iniciativa	Liderado por el gobierno local
Escala y sitio de la iniciativa	Ciudad – Querétaro
Principales actores	Gobierno del Estado de Querétaro Gobiernos de las Áreas Metropolitanas de Querétaro: • Gobierno Municipal de Querétaro • Gobierno Municipal de El Marqués • Gobierno Municipal de Corregidora • Gobierno Municipal de Huimilpan GESAB
Objetivo principal	Posibilitar el monitoreo en tiempo real y vigilancia del Área Metropolitana de Querétaro
Tecnologías usadas o desarrolladas	Plataforma Integrada
Descripción	El Centro de Información Segura y Análisis (CISA) es un Cuarto de Control de nivel estatal. Está conectado a cuartos de control municipales, incluidos los del área metropolitana de Querétaro, así como los de El Marqués, Corregidora y Huimilpan. Los último tres ya fueron construidos y el último (de la ciudad de Querétaro) está siendo construido en este momento. El CISA fue desarrollado por la compañía española GESAB.
Contacto	Israel Gálvez Rodríguez – Director de Inteligencia en la Secretaría de Seguridad de Querétaro.
Más información	Información de CISA en GESAB: https://gesab.com/portfolio-item/cias-queretaro/

Table 6. QUERETARO: REDCIAQ

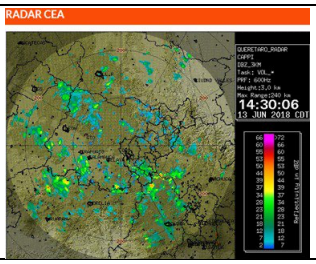
REDCIAQ	
Tipo de iniciativa	Consorcio Publico
Escala y sitio de la iniciativa	City – Querétaro
Principales actores	Gobierno de Querétaro Universidad Autónoma de Querétaro Sistema Nacional de Protección Civil UNESCO CONAGUA
Objetivo principal	Monitorear las lluvias a lo largo del estado de Querétaro
Tecnologías usadas o desarrolladas	Internet de las cosas y sensores Sensores remotos
Descripción	REDCIAQ es una iniciativa de monitoreo establecida en la ciudad de Querétaro. Su meta es mapear y reportar las lluvias extremas usando una red de sensores desplegada a lo largo de toda la ciudad. Es dirigida por la Facultad de Ingeniería de la Universidad Autónoma de Querétaro.
Contacto	Dr. Alfonso Gutiérrez L. Rafael E. Porras Trejo M.C. Israel Ruiz Ing. Alfredo Jiménez T.
Más información	REDCIAQ: http://www.redciaq.uaq.mx/ Noticias: http://www.redciaq.uaq.mx/index.php/prensa/63-uaq-y-agencia-espacial-mexicana-firman-convenio-de-colaboracion

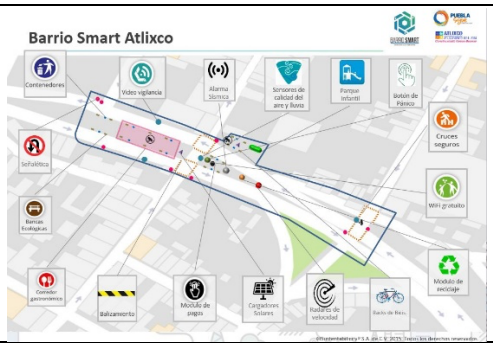
Table 7. QUERETARO: CIDESI

CIDESI	
Tipo de iniciativa	Consorcio Público-Privado
Escala y sitio de la iniciativa	Ciudad – Querétaro
Principales actores	CONAHCyT MABE Gobierno de Querétaro Intel General Electric IEEE
Objetivo principal	Desarrollo y producción de dispositivos de sensores
Tecnologías usadas o desarrolladas	Internet de las cosas y sensors Sensores remotos
Descripción	El CIDESI (Centro de Ingeniería y Diseño Industrial) tiene un laboratorio de micro tecnología. Ahí, los ingenieros e investigadores están desarrollando tecnologías de sensores para usarse en un amplio rango de industrias, espacios o problemas. Esto incluye un proyecto para instalar sensores en la ciudad de Querétaro, que sería usado para monitorear contaminación, lluvias, inundaciones, así como otros flujos.
Contacto	Dr. Carlos Rubio: crubio@cideci.edu.mx
Más información	CIDESI: https://www.cidesi.com/site/en/

Table 8. PUEBLA: Smart Puebla

Smart Puebla	
Tipo de iniciativa	Desarrollo Urbano
Escala y sitio de la iniciativa	Ciudad – Puebla
Principales actores	Gobierno de Puebla
Objetivo principal	Introducir tecnologías de ciudades inteligentes en la ciudad de Puebla
Tecnologías usadas o desarrolladas	Aplicaciones de teléfono inteligente Internet de las cosas y sensores
Descripción	Smart Puebla fue anunciada como una plataforma para transformar la ciudad en una ciudad inteligente con un enfoque en justicia social. Fue lanzada como una plataforma para permitir que diferentes actores en la ciudad colaboraran para encontrar soluciones a problemas urbanos. Las últimas actualizaciones al proyecto se hicieron a mediados de 2018, justo después de que se produjo un cambio en el gobierno de la ciudad, así como del estado, cuando Morena derroto en ambas al PAN. Smart Puebla incluyó el desarrollo de una aplicación de teléfono inteligente, acceso gratis a internet inalámbrico, un esquema de bicicletas compartidas, así como desarrollos de casas inteligentes (todo esto fue planeado, pero no construido).
Contacto	Consejeros en la “Smart Alliance Latin America”
Más información	Portal de Internet de Smart Puebla (que no funciona desde el 05/12/2019): http://smartpuebla.org/ Página de Facebook de Smart Puebla: https://es-la.facebook.com/SmartPuebla/ Reporte de Deloitte sobre Smart Cities in Mexico: https://www2.deloitte.com/content/dam/Deloitte/mx/Documents/public-sector/Ciudades-inteligentes.pdf

Table 9. PUEBLA: Barrio Smart Puebla

Barrio Smart Puebla	
Tipo de iniciativa	Desarrollo Urbano
Escala y sitio de la iniciativa	Ciudad – Atlixco/San Andrés Cholula
Principales actores	Gobierno de Atlixco Gobierno de San Andrés Cholula Gobierno de Puebla Barrio Smart
Objetivo principal	Desarrollo de Vecindarios Inteligentes en el estado de Puebla, en particular en las áreas metropolitanas.
Tecnologías usadas o desarrolladas	Internet de las cosas y sensores Crowdsourcing
Descripción	Barrio Smart se define como una iniciativa que reúne los esfuerzos de los sectores público y privado, respecto a ciudades inteligentes, con el objetivo de construir espacios que beneficien a todos los ciudadanos a través de las tecnologías urbanas. Lo hace a través de la mejora de infraestructura urbana, añadiendo tecnologías para la comunicación, dispositivos inteligentes, para impulsar el desarrollo económico. Lo hace a un nivel de vecindario, particularmente a través del despliegue de sensores en espacios públicos. En la ciudad de Atlixco estos sensores están monitoreando patrones de movilidad y flujos con el objetivo de optimizarlos. Se ha dicho que, a través de estos sensores, no solo se puede mejor la movilidad de ciclistas o personas caminando, pero también es posible que sean más seguras. Esto está implementándose en una zona de 12,000 metros cuadrados, con líneas de ciclistas, espacio de estacionamiento para ellos, así como acceso a internet inalámbrico. Para 2020, un año después de su instalación, algunos componentes del proyecto habían sido desmantelados por la nueva administración de la ciudad: https://www.elsoldepuebla.com.mx/local/estado/fracasa-barrio-smart-instalado-en-atlixco-puebla-2970452.html En el pueblo de Santa María Tonantzintla, al interior de la municipalidad de San Andrés Cholula, el proyecto de Barrio Smart fue detenido por un movimiento de la sociedad civil local: (https://www.theguardian.com/cities/2018/oct/16/the-mexican-town-that-refused-to-become-a-smart-city)
Contacto	Consejeros de la Smart Alliance Latin America

	José Luis Galeazzi – Es presidente municipal de Atlixco
Más información	Portal de Internet de Barrio Smart Puebla: http://barriosmartpuebla.com.mx/

Table 10. PUEBLA: C5 Puebla

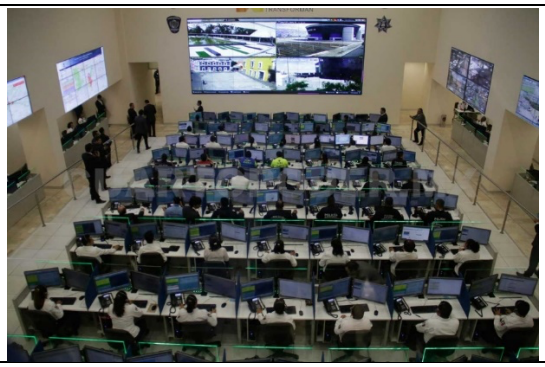
C5 Puebla	
Tipo de iniciativa	Dirigida por el gobierno estatal
Escala y sitio de la iniciativa	Estado – Puebla
Principales actores	Gobierno de Puebla Gobiernos municipales del estado de Puebla Gobierno Federal Auronix
Objetivo principal	Posibilitar el monitoreo en tiempo real y la vigilancia del Estado de Puebla, incluida el área metropolitana de Puebla.
Tecnologías usadas o desarrolladas	Plataformas integradas
Descripción	El Centro para el Control, Comando, Comunicaciones y Computación (C5) es una instalación estratégica que facilita las operaciones de emergencia, seguridad, monitoreo y control, usando cámaras, sensores, así como otras fuentes de información a lo largo del estado de Puebla. Está en contacto constante con los gobiernos municipales y federal, así como con otras dependencias en la administración estatal.
Contacto	Carla Morales Aguilar – Directora del C5
Más información	Portal del C5: http://cecsnsp.puebla.gob.mx/c5/

Table 11. ACAPULCO: C4

C4 Acapulco	
Tipo de iniciativa	Liderada por un gobierno local
Escala y sitio de la iniciativa	Ciudad – Acapulco
Principales actores	Gobierno of Acapulco Gobierno of Guerrero Gobierno Federal
Objetivo principal	Posibilitar el monitoreo en tiempo real y la vigilancia de la ciudad de Acapulco
Tecnologías usadas o desarrolladas	Plataforma integrada
Descripción	El C4 es una plataforma integrada que conecta video cámaras, sensores remotos y un cuarto de control en la ciudad de Acapulco. En 2016, el C4 de Acapulco estuvo bajo control militar. En los últimos años ha habido un intento para que el C4 incremente su cobertura para incluir cámaras en bares, avenidas, pero esto ha fallado hasta ahora. En agosto de 2019 se anunció que el C4 se expandiría sustancialmente y sería renombrado como C5. Esto implicaría la compra de nueva tecnología y una inversión sustancial de cien millones de pesos mexicanos. El gobierno del estado canceló esos planes en diciembre de 2019 debido a sus altos costos.
Contacto	Leoncio Daniel Guerrero Rodríguez – Director del C4
Más información	Sin información

Appendix 2. Summary tables of experiences with digital / smart technologies in other Mexican cities [IN SPANISH]

Table 12. GUADALAJARA: Ciudad Creativa Digital

Ciudad Creativa Digital (CCD)	
Tipo de iniciativa	Desarrollo Urbano
Escala y sitio de la iniciativa	Ciudad – Guadalajara
Principales actores	Gobierno de Guadalajara Gobierno Federal Conglomerado privado formado por Bosch, Cisco, IBM, Hewlett – Packard, entre otros. Asesorado por el MIT y el IEEE, entre otras instituciones.
Objetivo principal	Construir un barrio inteligente, creativo y digital en Guadalajara.
Tecnologías usadas o desarrolladas	Internet de las cosas y sensores
Descripción	La Ciudad Creativa Digital (CCD) es una iniciativa originalmente fundada por el Gobierno Federal mexicano en 2011, que seleccionó Guadalajara después de una convocatoria dirigida a todas las ciudades mexicanas. El objetivo del proyecto es construir el principal clúster de industrias creativas digitales en América Latina. Para ese fin, las asociaciones o colaboraciones con las empresas privadas fueron aseguradas. Se incluían aplicaciones, desarrollo de software, así como iniciativas de soporte de redes. De forma crucial la CCD está instalada en la zona central de Guadalajara, que fue identificada por tener problemas diversos problemas sociales, como una alta criminalidad, prostitución, pobreza e inequidad. El proyecto fue lanzado como un de redesarrollo urbano y no sólo como un hub digital. Entre otros pilares y componentes, el proyecto incluye un objetivo de ciudad inteligente. Específicamente, lo lograba al proponer el uso de una red de sensores que permitiría que el Centro de Datos de la CCD para responder en tiempo real a las demandas de los ciudadanos. Esto se haría mediante un monitoreo constante de áreas verdes, alumbrado público, seguridad pública, oferta de agua, entre otros servicios. Además, esta información sería compartida con usuarios de quioscos digitales localizados en el área.
Contacto	Carlos Eduardo Gutiérrez Medrano – Director de CCD

	Mauricio Navarro Gárate – Director del fideicomiso de CCD Víctor M. Larios – Líder Voluntario del “IEEE Smart Cities Initiative Guadalajara Pilot”
Más información	Sitio Oficial de Facebook de CCD (único portal disponible): https://www.facebook.com/CCDJalisco/ Reporte corto del IEEE sobre CCD: https://iot.ieee.org/articles-publications/smart-city-smart-future-guadalajara-mexico.html Reporte de Deloitte sobre Smart Cities in Mexico: https://www2.deloitte.com/content/dam/Deloitte/mx/Documents/public-sector/Ciudades-inteligentes.pdf

Table 13. GUADALAJARA: Ciudapp

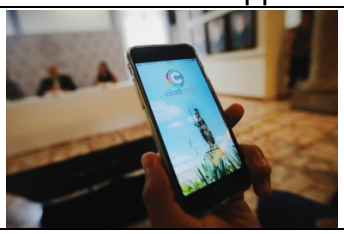
Ciudapp	
Tipo de iniciativa	Liderado por gobiernos locales
Escala y sitio de la iniciativa	Ciudad – Guadalajara
Principales actores	Gobierno de Guadalajara
Objetivo principal	Desarrollo de una aplicación para teléfonos inteligentes para facilitar la comunicación entre el gobierno y los ciudadanos.
Tecnologías usadas o desarrolladas	Aplicación para teléfonos inteligentes
Descripción	Esta aplicación es una nueva forma de participación ciudadana y constituye una herramienta para la comunicación directa entre los ciudadanos y el gobierno. La aplicación provee noticias relevantes, ofrece alertas en caso de eventos, como atascos de tráfico u otras disrupciones normales en el flujo de una ciudad, provee notificaciones personales a los usuarios, permite que usuarios con intereses similares se comuniquen, hace que los usuarios puedan levantar quejas y darles seguimiento, además de que busca desarrollar herramientas participativas.
Contacto	Coordinación General de Administración e Innovación Gubernamental
Más información	CiudApp site: http://ciudapp.mx

Table 14. JALISCO: Tequila inteligente

Tequila Inteligente	
Tipo de iniciativa	Desarrollo Urbano
Escala y sitio de la iniciativa	Ciudad – Tequila (Jalisco)
Principales actores	Gobierno Municipal de Tequila Gobierno Federal Gobierno de España IBM Google Hitachi Grupo JB (José Cuervo)
Objetivo principal	Construcción e instalación de numerosas tecnologías inteligentes en la ciudad de Tequila Jalisco.
Tecnologías usadas o desarrolladas	Aplicaciones de teléfonos inteligentes Internet de las cosas y sensores
Descripción	Tequila Inteligente busca transformar a la ciudad de Tequila en el primer pueblo mágico inteligente. Un pueblo mágico fue una marca desarrollada por la Secretaría de Turismo para preservar las características arquitectónicas de estas ciudades, usando dinero del gobierno federal para ello. En Tequila también existe un proyecto de desarrollo progresivo de tecnologías inteligentes para atraer nuevo turismo.
Contacto	Federico de Arteaga – JB Group Director
Más información	Portal de Internet de Tequila Inteligente: https://tequilainteligente.com/

Table 15. MEXICO DF: Agencia Digital de Innovación Pública

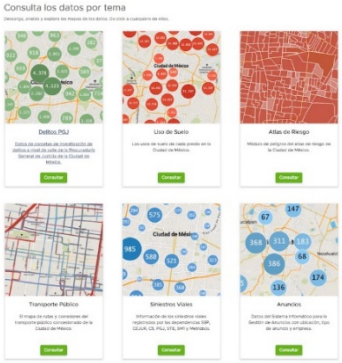
Agencia Digital de Innovación Pública (Digital Agency for Public Innovation)	
Tipo de iniciativa	Liderada por gobiernos locales
Escala y sitio de la iniciativa	Ciudad – Ciudad de México
Principales actores	Gobierno de la Ciudad de México
Objetivo principal	Desarrollo de herramientas digitales para la gobernanza urbana
Tecnologías usadas o desarrolladas	Big Data; Aplicaciones para teléfonos inteligentes; Crowdsourcing.
Descripción	La Agencia Digital para la Innovación Pública es responsable de liderar, diseñar y dar seguimiento a la implementación de un conjunto de políticas, incluidas la de gestión de datos, gobierno abierto, gobierno digital, gobernanza tecnológica, así como la gobernanza de la infraestructura de la Ciudad de México. Entre sus objetivos está: Elaborar un registro digital que permita a los ciudadanos ver cómo el dinero público ha sido utilizado Eliminar, reducir y simplificar los procedimientos burocráticos Eliminar intermediarios entre el gobierno de la Ciudad de México y sus ciudadanos para evitar la corrupción Crear una plataforma digital para servicios públicos, par disminuir la necesidad de visitar las oficinas gubernamentales diariamente. Crear un archivo digital que incluya todos los indicadores de la Ciudad de México y lo hagan de acceso abierto Promover políticas públicas basadas en evidencia a través del archivo digital y de datos.
Contacto	José Merino – Director: jmerino@cdmx.gob.mx
Más información	Portal de la ADIP: https://adip.cdmx.gob.mx/

Table 16. MEXICO DF: Virk Smart City

Virk Smart City	
Tipo de iniciativa	Empresa privada que ofrece productos o servicios
Escala y sitio de la iniciativa	A lo largo de América Latina (pero con base en Ciudad de México)
Principales actores	Virk UNDP Amnistía International Transparencia Internacional El Banco Mundial Centro Internacional de Periodismo
Objetivo principal	Proveer soluciones de ciudades inteligentes (entre otros servicios de investigación y periodismo).
Tecnologías usadas o desarrolladas	Ofrecen un conjunto de productos de ciudades inteligentes, incluyendo: Internet de las cosas y sensores Aplicación de teléfonos inteligentes Plataformas integradas
Descripción	Virk es una consultoría establecida en México, fundada parcialmente mediante apoyos internacionales. Su alcance original fue proveer servicios digitales y herramientas para investigadores de periodismo en la región, pero se ha expandido para incluir soluciones de ciudades inteligentes: Virk es una compañía mexicana enfocada en crear herramientas tecnológicas para recolectar, procesar y analizar datos de tiempo real creados en cualquier medio digital. Sus productos apoyan la identificación y solución de asuntos de potencial público, con énfasis en visualización de contenidos y socialización.
Contacto	Iván Yza, Director General. Valeria Tirado, COO.
Más información	Portal de Virk Smart City: https://virkapp.com/virk-smart-city/

Table 17. MEXICO DF: Smart Cities México

Smart Cities Mexico	
Tipo de iniciativa	Empresa privada que ofrece productos o servicios
Escala y sitio de la iniciativa	Empresa establecida en México que ofrece soluciones en una escala mundial.
Principales actores	
Objetivo principal	Compañía que desarrolla soluciones inteligentes para ciudades en México
Tecnologías usadas o desarrolladas	N/A
Descripción	Smart Cities México es una compañía que ofrece planes de acción y soluciones para desarrollar de forma integral todos los aspectos que le dan forma a una Ciudad Inteligente. No desarrollan tecnología, pero si modelos de gestión, políticas públicas y estrategias.
Contacto	No existe un contacto claro más allá del correo general: info@smartcitiesmexico.mx
Más información	Portal de Smart Cities Mexico: https://smartcitiesmexico.mx/

Tabla 18. Ho1a Innovación

Ho1a Innovación	ho1a. Innovación
Tipo de iniciativa	Empresa privada que ofrece productos y servicios
Escala y sitio de la iniciativa	Mundial (basada en Guadalajara)
Principales actores	
Objetivo principal	Empresa que desarrolla soluciones de ciudades inteligentes para ciudades mexicanas.
Tecnologías usadas o desarrolladas	Plataformas integradas Big Data Internet de las cosas y sensores
Descripción	ho1a es una empresa mexicana de tecnologías de información fundada hace 25 años, que es parte de Megacable desde 2015. Ofrece soluciones de TI para el sector privado, así como para gobiernos. Esto incluye desarrollo de infraestructura y gestión, así como almacenamiento y análisis basado en la nube. La empresa tiene alianzas comerciales con Avaya, Cisco, EMC2, Google, HP, Huawei, Microsoft and VMware, entre otros.
Contacto	Edgar López Fuentes – Gerente de Desarrollo de Negocios
Más información	Portal de ho1a: https://www.ho1a.com/acerca-de-ho1a/

Table 19. MEXICO DF: Huawei

Huawei	
Tipo de iniciativa	Empresa privada que ofrece productos y servicios
Escala y sitio de la iniciativa	Mundial, con oficinas en Ciudad de México
Principales actores	
Objetivo principal	Empresa que comercializa tecnologías inteligentes para ciudades en México
Tecnologías usadas o desarrolladas	Big data
Descripción	Huawei es una empresa china que vende soluciones para ciudades inteligentes. Su producto estrella es una arquitectura informática de big data que permite a los funcionarios de la ciudad utilizar este tipo de información y análisis: Según la empresa, grandes cantidades de datos están impactando el crecimiento económico, la consolidación de industrias y los patrones de construcción urbana. Big Data juega con frecuencia un papel importante en el proceso de desarrollo de Ciudades Seguras a través de la predicción, el análisis y la minería para el desarrollo comercial futuro. La disponibilidad y el consumo de datos abiertos está creando nuevas oportunidades para los proveedores de servicios de Big Data preparados para tomar la iniciativa. El Big Data es una piedra angular indispensable para los ecosistemas de Smart City. Por ejemplo, los gobiernos recopilan datos de las industrias locales para tomar decisiones sobre desarrollos futuros basados en la ciencia estadística. Esta estrategia permite personalizar los servicios centrados en los ciudadanos a partir de los conocimientos de Big Data derivados de factores críticos de desarrollo económico. Los planificadores de Smart City pueden centrarse en la divulgación de datos gubernamentales y las transacciones de mercado para aprovechar el valor de los datos recopilados para optimizar las operaciones de la ciudad. Las plataformas de Big Data desempeñan un papel importante en la integración de datos personales para calcular la distribución de la población y los patrones de transporte y consumo, así como los datos de la industria sobre los sectores inmobiliario, financiero, manufacturero y energético.
Contacto	Luis Adolfo Guillot Dueñas – Government Solutions CTO
Más información	Huawei Government Solutions: https://e.huawei.com/es/solutions/industries/government Huawei Big Data for Smart Cities report: https://e.huawei.com/es/publications/global/ict_insights/201701051027/hands-on-technology/201701060856

Table 20. MEXICO DF: NEC Smart City

NEC Smart City	
Tipo de iniciativa	Empresa privada que ofrece productos o servicios
Escala y sitio de la iniciativa	Mundial, con oficinas en Ciudad de México
Principales actores	NEC
Objetivo principal	Empresa que comercializa tecnologías inteligentes para ciudades en México
Tecnologías usadas o desarrolladas	Plataformas integradas
Descripción	NEC es una corporación japonesa que vende, entre otros productos, soluciones de ciudades inteligentes a escala global. Estos se centran en un producto: Cloud City Operations Center (CCOC): una solución integral que permite a cualquier operador administrar, interpretar y automatizar los resultados de los datos recopilados en cualquier sistema ciber físico. Esta solución está diseñada para cumplir con los requisitos de una ciudad inteligente de una manera flexible, eficiente y rentable. Además, es compatible con FIWARE, lo que permite el desarrollo de nuevas aplicaciones apiladas. El CCOC integra sensores remotos, sensores ciudadanos y otros datos recopilados de IoT para permitir que los funcionarios de la ciudad tomen decisiones a través de un panel de control de la ciudad.
Contacto	Luis Rodrigo Barajas Escalante – Director de Desarrollo de Negocios de Smart City.
Más información	Portal de NEC para Mexico: http://www.necsmartit.com/?lang=es

Table 21. MEXICO DF: IBM Smarter Cities

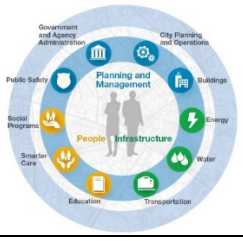
IBM Smarter Cities	
Tipo de iniciativa	Empresa privada que ofrece productos o servicios
Escala y sitio de la iniciativa	Mundial, con oficinas en México
Principales actores	IBM
Objetivo principal	Empresa que comercializa tecnologías inteligentes para ciudades en México.
Tecnologías usadas o desarrolladas	Plataformas integradas; Internet de las cosas y sensores Big Data
Descripción	La empresa menciona que su tecnología permite analizar el futuro de las ciudades. Señalan que a medida que los gobiernos nacionales se centran cada vez más en los problemas nacionales, las ciudades deben aprovechar más las tecnologías más avanzadas para actualizar la prestación de servicios. Los nuevos modelos de negocio apuntan a la creación de nuevas eficiencias radicales para desafíos de larga data. La informática cognitiva y su capacidad para fomentar la participación ciudadana presenta nuevas oportunidades para que las organizaciones gubernamentales mejoren la vida de los ciudadanos y el entorno empresarial, brinden experiencias personalizadas y optimicen los resultados de los programas y servicios.
Contacto	Ana Hentze – Arquitecta de Soluciones en la Nube, IBM Mexico
Más información	Portal de Ciudades inteligentes de IBM: https://www.ibm.com/smarterplanet/us/en/smarter_cities/overview/

Table 22. MEXICO DF: IBM Smarter Cities

Cisco Cities and Communities	
Tipo de iniciativa	Empresa privada que ofrece productos o servicios
Escala y sitio de la iniciativa	Mundial, con oficinas en México
Principales actores	Cisco
Objetivo principal	Company commercialising smart technologies for cities in Mexico
Tecnologías usadas o desarrolladas	Plataformas integradas; Internet de las cosas y sensores Big Data
Descripción	Cisco es una empresa global que vende soluciones inteligentes para ciudades en diferentes áreas, como iluminación, movilidad, seguridad y protección, medio ambiente y gestión de residuos. En México, son socios en varias iniciativas y aliados comerciales con empresas locales.
Contacto	Juan Cepeda, Director de Estrategia y Planeación de Cisco México
Más información	Portal de: “Cisco Smart Connected Communities”: https://www.cisco.com/c/en/us/solutions/industries/smart-connected-communities.html

Appendix 3. Summary tables of experiences on disaster risk response via digital / smart technologies [IN SPANISH] digital

Table 23. #Verificado19S

#Verificado19S	#VERIFICADO19S
Tipo de iniciativa	Sociedad Civil
Escala y sitio de la iniciativa	Ciudad – Ciudad de México
Principales actores	Colectivo #Verificado19S Google
Objetivo principal	Respuesta y alivio a terremotos
Tecnologías usadas o desarrolladas	Crowdsourcing
Descripción	#Verificado19s nació de la reacción de la sociedad civil en la Ciudad de México como lo atestiguaron miembros del colectivo luego del terremoto del 19 de septiembre de 2017. La evidente falta de información útil –actualizada, veraz y clara– fundamental para orientar a la sociedad civil en su respuesta al terremoto, motivó al Arquitecto Sergio Beltrán-García a crear una capa en Mis Mapas, para etiquetar los edificios que habían sido dañados a lo largo de la ciudad. Al principio estos fueron verificados por él personalmente, pero poco después también empezó a incluir los que habían sido denunciados por diversas redes comunitarias a través de WhatsApp y Twitter. Paralelamente, decidió dejar abierto el acceso a esta capa, para que otras personas pudieran editar y etiquetar los edificios dañados restantes. Transcurridas aproximadamente 5 horas se produjo un impasse: aunque ya se había bloqueado el acceso público, las diferentes capas que se compartían con el grupo incipiente habían comenzado a editarse punto a punto, y la capacidad de My Maps había llegado a su límite. Se requirió una estrategia más compleja para facilitar la operación. El plan era dividir el trabajo entre un equipo de campo y un equipo de inteligencia. Con esto en mente, buscaron el apoyo de Google México para facilitar el uso de este mapa por parte de nuestro equipo de inteligencia.
Contacto	Jerónimo Esquinca – Colectivo #Verificado19S Sergio Beltrán García – Colectivo #Verificado19S Ana Givaudan Díaz – Colectivo #Verificado19S

	Lina Ornelas – Directora de Asuntos de Gobierno y Política Pública de Google Mexico. of Government Affairs and Public
Más información	Reporte de Google sobre #Verificado19S: https://about.google/intl/ALL_uk/stories/verificado19s/?utm_source=google&utm_medium=hpp&utm_campaign=UK Informe: Comunicación en situaciones de desastre: recomendaciones para la sociedad civil a partir de la experiencia de miembros de #Verificado19S https://play.google.com/store/books/details/Ana_Givaudan_Communication_in_disaster_situations?id=MFSMDwAAQBAJ

Table 24. Cerebro México

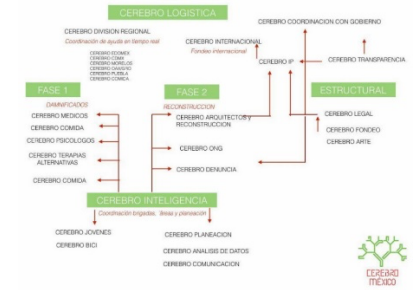
Cerebro México	
Tipo de iniciativa	Sociedad civil
Escala y sitio de la iniciativa	Ciudad – Ciudad de México; Nivel estatal – Puebla; Morelos, Oaxaca, Guerrero
Principales actores	Voluntarios en las ciudades y estados donde Cerebro estuvo activo
Objetivo principal	Respuesta y alivio a terremotos
Tecnologías usadas o desarrolladas	Redes Sociales (WhatsApp) Crowdsourcing
Descripción	Cerebro es una organización de la sociedad civil que busca “diseñar alternativas de gobierno que partan del ciudadano”. Antes del terremoto del 19 de septiembre de 2017, Cerebro tenía un chat de WhatsApp para ocho personas que se usaba para "planificar cómo generar dinámicas que permitieran a las personas pensar colectivamente". Después del terremoto, Cerebro se expandió a Puebla, Morelos, Oaxaca y Guerrero. Después de seis días, se crearon charlas temáticas, donde los voluntarios podían discutir temas relacionados con, por ejemplo, ingeniería, alimentos, asistencia médica o población juvenil. Estos chats se expandieron e incluyeron hasta 700 personas, llegando potencialmente a alrededor de 15,000 personas, según Cerebro. Estos chats conectaron a voluntarios de las regiones afectadas por el terremoto. Además, cada chat permitió identificar “contactos confiables en áreas vulnerables”, quienes luego se convirtieron en coordinadores de área. Esto permitió a los voluntarios ponerse en contacto directamente con las personas afectadas por el desastre, respondiendo a sus “necesidades específicas” en “tiempo real”. Después del terremoto, Cerebro ha creado campañas para continuar recolectando apoyo, ayudando a reconstruir las casas dañadas y conectando a los interesados en implementar proyectos en las áreas dañadas.
Contacto	Carolina Salinas, Fundadora: https://www.linkedin.com/in/mcarosalinasl/
Más información	Cerebro Mexico: https://cerebromexico.com/

Table 25. Centro de Instrumentación y Registro Sísmico AC (CIRES)

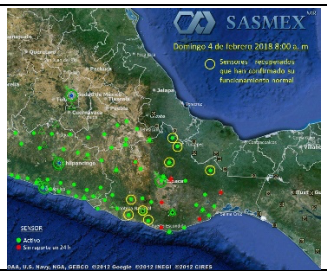
Centro de Instrumentación y Registro Sísmico AC (CIRES)	
Tipo de iniciativa	Sociedad civil
Escala y sitio de la iniciativa	Varios estados y ciudades de México: Ciudad de México, Oaxaca, Puebla, Guerrero, Colima y Michoacán.
Principales actores	CIRES Gobierno de la Ciudad de México Gobierno de Oaxaca Gobierno Federal
Objetivo principal	Monitoreo de terremotos
Tecnologías usadas o desarrolladas	Sensores remotos Internet de las cosas y sensores
Descripción	SASMEX ahora monitorea las costas de los estados de Jalisco, Colima, Michoacán, Guerrero, y Oaxaca, así como Puebla, con el objetivo de hacer más eficientes los sistemas de alerta. A su vez, CIRES se ha propuesto utilizar sus alertas en otras ciudades además de Ciudad de México, Morelia, Puebla, Acapulco, Chilpancingo y Oaxaca, donde actualmente se encuentra desplegado, así como extender su alcance a Veracruz.
Contacto	Juan Manuel Espinosa, Director General: http://linkedin.com/in/juan-manuel-espinosa-aranda-08995b3a Correo: correo@cires.org.mx
Más información	Portal de CIRES: http://www.cires.org.mx/

Table 26. App 9-1-1

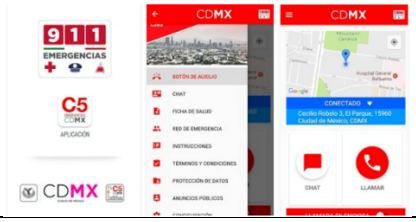
App 9-1-1	
Tipo de iniciativa	Liderado por gobierno local
Escala y sitio de la iniciativa	Ciudad – Ciudad de México
Principales actores	Gobierno de la Ciudad de México CIRES
Objetivo principal	Respuesta y monitoreo de emergencias
Tecnologías usadas o desarrolladas	Aplicación de teléfonos inteligentes
Descripción	La aplicación 9-1-1 es una aplicación para teléfonos inteligentes desarrollada recientemente por el gobierno de la Ciudad de México. Proporciona una conexión directa entre los usuarios de teléfonos inteligentes y las autoridades en una variedad de temas. La aplicación se puede utilizar para informar cualquier emergencia, como un robo, asalto, secuestro, etc., y también puede transmitir alertas de terremoto utilizando la infraestructura de CIRES. Finalmente, la aplicación permite a los usuarios crear grupos de familiares y amigos con los que se contactará automáticamente en caso de emergencia.
Contacto	María de los Ángeles Jaca Morán – Subdirectora para el Monitoreo Inteligente. mjacam@c5.cdmx.gob.mx Juan Manuel García Ortegón – Director del C5 de la Ciudad de México. jgarciao@c5.cdmx.gob.mx
Más información	Información de la Ciudad de México government information sobre 9-1-1 App: https://www.c5.cdmx.gob.mx/canales-de-atencion-emergencias/app-9-1-1-de-la-cdmx

Table 27. Grillo.io

Grillo.io	
Tipo de iniciativa	Empresa privada que ofrece productos y servicios
Escala y sitio de la iniciativa	Familiar A lo largo de todo el país
Principales actores	Grillo
Objetivo principal	Monitoreo de terremotos
Tecnologías usadas o desarrolladas	Aplicaciones de teléfonos inteligentes Sensores remotos Internet de las cosas y sensores
Descripción	Es una alarma inteligente diseñada para integrarse en el hogar, fácil de instalar, conectada a la red de sensores sísmicos de Grillo y que puede alertar instantáneamente sobre amenazas en el hogar. Grillo es una alarma de peligro inteligente que se integra en su hogar. Fácil de instalar, fácil de usar y te alerta instantáneamente sobre terremotos inminentes y otros peligros. Se ha desarrollado la red de sensores más rápida y precisa de México para alertas tempranas de terremotos.
Contacto	Luis Rodríguez – Director de Ingeniería de Sismos en Grillo: https://www.linkedin.com/in/luisrodriguezabreu/
Más información	Portal de Grillo.io: https://grillo.io/ Twitter: https://twitter.com/grilloalerta

Table 28. SkyAlert México

SkyAlert México	
Tipo de iniciativa	Empresa privada que ofrece productos y servicios
Escala y sitio de la iniciativa	A nivel nacional
Principales actores	SkyAlert S.A.P.I. de C.V.
Objetivo principal	Monitoreo de terremotos
Tecnologías usadas o desarrolladas	Aplicaciones de teléfonos inteligentes Sensores remotos Internet de las cosas y sensores
Descripción	SkyAlert utiliza los servicios en la nube de Microsoft Azure para transmitir datos y recientemente ha desarrollado un producto orientado a los negocios llamado "Epicenter", que gestiona la evacuación de edificios a través de IoT. Específicamente, Epicenter toma el control de diversas acciones como abrir puertas, detener maquinaria, cerrar válvulas en caso de desastre, y puede ser programado para gestionar simulacros, entre otras funciones.
Contacto	Alejandro Cantú - CEO
Más información	Portal de SkyAlert: https://skyalert.mx/

Table 29. Alerta Sísmica DF

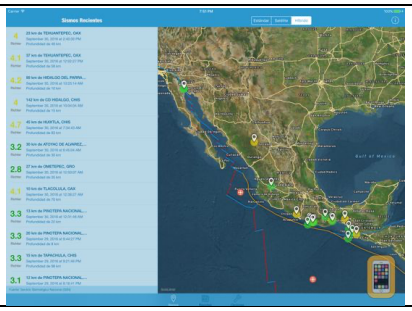
Alerta Sísmica DF	
Tipo de iniciativa	Empresa privada que ofrece productos y servicios
Escala y sitio de la iniciativa	Ciudad de México
Principales actores	SocialPlatform5.com
Objetivo principal	Monitoreo de Terremoto
Tecnologías usadas o desarrolladas	Aplicación de teléfono inteligente
Descripción	Alerta Sísmica DF es una aplicación para teléfonos inteligentes, tabletas y computadoras de escritorio que utiliza la red de monitoreo sísmico de CIRES para emitir alertas de terremotos.
Contacto	
Más información	Portal de Alerta Sísmica DF: https://alertasismica-df.com/

Table 30. TecnoAyuda 19S

TecnoAyuda 19S	
Tipo de iniciativa	Sociedad Civil
Escala y sitio de la iniciativa	Nacional (establecida en Aguascalientes)
Principales actores	Civismo Digital MX TechnoPoli IPN La Casa del Inventor en Aguascalientes INFOTEC Gobierno de Aguascalientes
Objetivo principal	Respuesta a desastres y emergencias
Tecnologías usadas o desarrolladas	Ninguna, es una red para promover tecnologías ya existentes.
Descripción	A raíz de los terremotos de 2017, en particular el del 19 de septiembre, un grupo de organizaciones de la sociedad civil, instituciones educativas y funcionarios gubernamentales se reunieron con el objetivo de identificar y señalar las intervenciones tecnológicas ya disponibles para responder a desastres y emergencias. Para ello, se convocó a una conferencia donde se presentaron algunas tecnologías, y se hizo un llamado para que sean adquiridas y producidas en mayor número para ser utilizadas en zonas de desastre.
Contacto	Korina Velázquez – Director de Civismo Digital MX
Más información	Portal de TecnoAyuda 19S: http://tecnoayuda19s.org.mx/

Table 31. RieSis

RieSis	
Tipo de iniciativa	Sociedad Civil
Escala y sitio de la iniciativa	Nacional (con base en Ciudad de Mexico)
Principales actores	IPN – Centro de Investigación en Computación Gobierno de la Ciudad de México
Objetivo principal	Monitoreo y respuesta ante terremotos
Tecnologías usadas o desarrolladas	Plataforma integrada
Descripción	RieSis fue desarrollado entre 2012 y 2013 por la institución de educación pública IPN, parcialmente financiado por el gobierno de la Ciudad de México, y bajo la dirección del Dr. Adolfo Guzmán Arenas. RieSis es un software que integra información de varias fuentes, incluidas las bases de datos del gobierno local (que deben ingresarse manualmente); comunica mensajes en emergencias y desastres mediante mensajería de texto y aplicaciones móviles como WhatsApp; asigna automáticamente personal de rescate a los sitios de acuerdo con las prioridades; utiliza la tecnología de Google para crear mapas digitales; permite que las víctimas potenciales ingresen información; y permite que los voluntarios se registren, entre otras cosas. El software está disponible para su compra en México.
Contacto	Adolfo Guzmán Arenas – Desarrollador
Más información	Artículo sobre RieSis por Adolfo Guzmán (en español): https://www.revistaciencia.amc.edu.mx/images/revista/69_1/PDF/RieSis.pdf