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Building City Resilience through Collaboration

DISSERTATION

submitted for the Degree of Doctor of Philosophy by

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Abstract

Nowadays, the majority of the world's population lives in cities and, according to projections, this number will increase over the coming decades. Accelerated globalization has dramatically increased the complexity and perceived unpredictability of threats and hazards. As cities continue to grow and grapple with uncertainties, cities across the world face an increasing variety of challenges ranging from short-term disasters such as floods, droughts, and earthquakes, to long-term disasters such as climate change.

In most cities, the approach to managing disasters has limited to top-down initiatives directed by disjointed departments and entities of the local government who adopted a reactive response to disasters. In this context, city stakeholders such as volunteer organizations, citizens, media, academic, educational and scientific entities, and private and public companies were informed without becoming actively involved in the resilience-building process.

The capacity of a city to adapt to disasters requires a resilience approach that not only takes into consideration the contribution of each stakeholder independently but also tackles the functioning of a city in a comprehensive and holistic manner. The approach to building resilience focuses on the innate strengths of city stakeholders and the need to collaborate to maximize

efforts and existing resources. Building city resilience therefore, requires analyzing the needs of the different city stakeholders and empowering them to take actions.

Currently, however, frameworks that help governments to improve collaboration with city stakeholders in the resilience-building process remain undeveloped. Therefore, frameworks that help local governments to understand and assess how to engage stakeholders at the most appropriate time and in a manner that contributes to the resilience-building process need to be developed. The contribution of this research is the development of a stakeholder-collaboration maturity model. The stakeholder-collaboration maturity model defines five sequential maturity stages to help local governments to improve progressively the collaboration with city stakeholders in the resilience-building process. Each maturity stage indicates the stakeholders that need to be involved, the policies that need to be implemented, and the indicators that evaluate the implementation of the policies.

The stakeholder-collaboration maturity model was developed as a result of an iterative process that included semi-structured interviews with representatives from six different cities committed to improving their level of city resilience. Furthermore, two case studies were carried out in two cities in order to implement the stakeholder-collaboration maturity model. These case studies aimed at gathering evidence of the evolution of the collaboration between the local government and city stakeholders and to validate the sequence of stages and policies presented in the maturity model. Moreover, the stakeholder-collaboration maturity model made it possible to assess the current maturity stage of the cities under study and to provide recommendations for improving collaboration with different city stakeholders.

1 Introduction

Cities are connected and mutually interdependent systems made up of a diverse and complex mix of institutions, ecosystems, assets, and infrastructure that are essential for the welfare of society. Disruption to one part of the system can cause failure in other parts, with local, regional, and global implications. Thus, failing to collaborate in disaster situations increases the vulnerability of cities towards potential disasters. In this vein, the capacity of a city to adapt to disasters requires a resilience approach that not only takes into consideration the contribution of each stakeholder independently but tackles the functioning of a city in a comprehensive and holistic manner.

Building city resilience requires collaboration between city stakeholders in order to foster local capacities and pool resources available. Currently, however, local governments encounter challenges to collaborate with different city stakeholder. This research aims at developing a stakeholder-collaboration maturity model to improve progressively the collaboration between the local governments and city stakeholders in the resilience-building process.

1.1 Overview

The increasing occurrence of disasters has highlighted the exposure of cities to natural disasters and emphasized the need of making cities resilient to disasters (Malalgoda et al., 2014). Data shows that the frequency of natural disasters is increasing across the world (see Figure 1.1). Furthermore, 2016 ended as the warmest year ever recorded, since global land and ocean temperature records are kept (Aon Benfield, 2016). In this vein, the links between disasters and climate change are increasingly being recognized (O'Brien & Read, 2005). Nowadays, there are growing concerns over the threats posed by climatological hazards such as the impact of higher temperatures, drought and wild fires and the multi-faceted threats associated with sea level rise (Haigh & Amaratunga, 2010).



Figure 1.1: Frequency of natural disasters.

The United Nations International Strategy for Disaster Reduction (UNISDR) defines a disaster as “a serious disruption of the functioning of a community or a society involving widespread human, material, or environmental losses and impacts that exceeds the ability of affected community to cope using only its own resources” (UNISDR, 2007). Short-term disasters are natural or man-made events that cause a disaster,

whereas long-term disasters are natural or man-made factors that cause underlying damage without directly leading to a full blown disaster (UNISDR, 2015a). Progress in disaster risk reduction research has shown that it is often not the hazard that determines a disaster, but the vulnerability, exposure, and ability of the population to anticipate, respond, and recover from its effects (Aitsi-Selmi et al., 2015).

1.2 Disaster management approach

Disaster management involves the establishment of plans, structures, and arrangements to engage the governments and emergency services with the responsibility of managing risks in a coordinated way to respond to the whole spectrum of disaster (Lin Moe & Pathranarakul, 2006). The local government has the main responsibility for planning and coordinating disaster management at the city level (Aedo et al., 2010, Waugh & Streib, 2006). In addition to the local governments, the emergency services are the entities and the organizations in charge of responding and providing their services first to disasters (Kapucu et al., 2010). The emergency services include the emergency coordinators and the first responders such as the police, the firefighters, and the health services (Kapucu, 2008).

Disaster management is interchangeably used with the term emergency management (Lin Moe & Pathranarakul, 2006). However, there are differences between these two terms. Emergencies become disasters if the emergency resources and procedures are insufficient to manage the disaster response and recovery (Hernantes et al., 2013). Therefore, emergencies do not become disasters if existing resources and remedies are adequate to maintain order (Labaka, 2013, Waugh & Streib, 2006).

Disaster management is a cooperative process that requires the active and coordinated participation of a wide variety of stakeholders with the responsibility for managing disasters (Waugh & Streib, 2006). Disaster management is composed of four phases: prevention-mitigation, preparedness, response, and recovery (see Figure 1.2). The first two phases occur before the

occurrence of the disaster and the last two afterwards (Waugh & Streib, 2006, Kapucu, 2008).



Figure 1.2: Disaster management phases.

- The prevention and mitigation phase refers to the actions that prevent a disaster to happen, or reduce the impact of future disasters (e.g. land-use planning and evacuation planning).
- The preparedness phase refers to the actions taken to reduce the impacts of disasters when they are forecasted or imminent (e.g. execution of evacuation disaster planning or training).
- The response phase refers to the actions taken during the initial impact of a disaster and the short-term aftermath (e.g. safeguarding human lives, conducting search and rescue activities, and preventing further damage to property).
- The recovery phase refers to the actions aimed at returning to normality repairing damage (e.g. restoring services and reconstructing facilities).

Disaster management phases are cyclical and require the collaborative participation and the involvement of diverse expertise and variety of organizations (Laakso & Palomäki, 2013). When a disaster occurs, the local government departments and emergency services cannot always cope with the resulting widespread impacts unless further stakeholders are available to acquire

resources and take care of broader response and recovery needs (McEntire, 2007). During the four phases of disaster management, multi-stakeholder collaboration enhances the exchange of information and the coordination of the response and recovery efforts (Laakso & Palomäki, 2013, Sawalha, 2014).

Previously developed relationships between the governmental entities in charge of disaster management and other public agencies, private companies, and volunteer organizations, are vital for the effectiveness of disaster management (Kapucu, 2008). Building and sustaining functional inter-organizational collaboration agreements, helps disaster management organizations to share information, resources, and human capital as well as effectively coordinate their efforts in response to disasters and subsequent recovery (Kapucu & Hu, 2014).

1.2.1 Limitations in disaster management approach

Natural disasters have a very low or unknown probability of occurring, but if they do happen, they generate enormous losses (McEntire, 2007). Due to the low probability of occurrence of disasters, getting the society to participate in disaster preparedness is difficult (White et al., 2014). One of the existing challenges in the disaster management field is that the general attitude to disaster preparedness is characterized by the complacency of society (Kapucu, 2008). Most citizens and institutions do not perceive themselves as being responsible for disaster preparedness, as there are designated entities from the emergency services in charge of dealing with the impacts of disasters and protecting citizens (McEntire, 2007, Yosefi Mojir & Pilemalm, 2013).

Another challenge is that the approach to managing disasters is limited to top-down initiatives directed by independent departments and entities from the local government and emergency services (Collier et al., 2013, O'Brien & Read, 2005). These departments and entities have distinct responsibilities and limited connection to each other and therefore, offer their services autonomously and store and analyze critical information on an individual basis (Albright & Crow, 2015, Prior & Roth, 2013). As consequence, it is a challenge for local governments to have an overall view of the city and coordinate the different entities and departments involved in its functional operation (Harrison & Williams, 2016).

In view of these challenges, the need for a holistic resilience approach that integrates disaster reduction and response efforts and practices across the wide variety of stakeholders of a city has been emphasized in the last years (Djalante, 2012). Whereas traditional approaches to disaster management have relied upon a narrow range of governmental entities, contemporary and future schemas foster the involvement of a full range of stakeholders, professionals and community groups into the resilience-building process (Coaffee, 2013).

1.3 Disaster resilience

In recent years, there have been international moves towards disaster management approaches that focus on building up the resilience of cities by fostering the capacity of the local stakeholders (McLennan et al., 2015, Prosser & Peters, 2010). The term resilience is increasingly used in disaster management field to develop a proactive approach to a wide spectrum of disasters, ranging from long-term stresses such as environmental pollution, ground water depletion or deforestation, to short-term disasters such as floods, droughts, earthquakes, hurricanes or wildfires (Harrison & Williams, 2016, O'Brien & Read, 2005). Disaster resilience covers the ability of a city to understand the disaster risks it may face, to mitigate those disaster risks, and to respond to disasters that may occur, in such a way as to minimize loss of or damage to life, livelihoods, property, infrastructure, economic activity and the environment (Spaans & Waterhout, 2017).

Resilience encompasses a whole risk approach that integrates effectively disaster risk reduction, business continuity planning, disaster management and response, critical infrastructure protection, and climate change adaptation into a single unified framework (Prior & Roth, 2013, Shaw, 2012) (see Figure 1.3). The process of building disaster resilience is an integrated approach, not one based on a single system, sector, or discipline (Cutter et al., 2013). Therefore, building resilience requires a greater coherence of policy across different departments, disaster management entities, and institutions (Prior & Roth, 2013, Wright, 2016).



Figure 1.3: Disaster resilience.

A resilience-focused approach accepts the possibility that a wide range of disruptive events, both short-term and long-term disasters, may occur but are not necessarily predictable. In this context, the concept of resilience focuses on enhancing the performance of a system in the face of multiple disasters, rather than preventing or mitigating the loss of assets due to specific events (Rockefeller Foundation & ARUP, 2014). A resilience-focused approach shifts the focus in preparedness planning from a traditional top-down perspective, where the authorities assume responsibility for managing the effects of a disaster, to bottom-up thinking that builds on existing capabilities of the involved stakeholders (Weichselgartner & Kelman, 2014).

The approach to building resilience focuses on the innate strengths of a wide variety of stakeholders such as the emergency services, volunteer organizations, citizens, academic and scientific entities, the media, and public and private companies (Cavallo & Ireland, 2014, Malalgoda et al., 2014). The involvement of stakeholders maximizes the benefits of the resilience-building process fostering local capacities and pooling available resources (Oxley, 2013). In this vein, the

role of the local governments is predominantly critical as making and maintaining the necessary linkages across the city stakeholders is a challenge (da Silva et al., 2012, Brown et al., 2012). This raises the question of how local governments can promote stakeholder collaboration in the resilience-building process (Cavallo & Ireland, 2014).

1.4 Research objectives

The main objective of this research is to develop a stakeholder-collaboration maturity model for improving progressively the collaboration between the local government and the city stakeholders in the resilience-building process. Following, the sub-objectives to reach the overall goal of this research are defined:

1. Identify and validate the principles that improve through the collaboration of stakeholders in the city resilience-building process.
2. Define a sequence of maturity stages that the local government needs to follow to improve the collaboration with city stakeholders in the resilience-building process.
3. Define for each maturity stage the policies that need to be implemented and the stakeholders that need to be involved in the implementation of the policies.
4. Identify the roles and responsibilities of the city stakeholders throughout the maturity stages.
5. Provide indicators for assessing the implementation of the polices defined in the stakeholder-collaboration maturity model.

1.5 The structure of the thesis

The following chapters of this thesis are structured as follows:

- *Chapter 2* describes literature review that was undertaken on the concept of city resilience and existing frameworks, maturity models, and standards to improve city resilience. It gives a comprehensive overview of the findings that have been identified in the literature and the limitations of previous studies.
- Chapter 3 explains the research methodology applied in this research to develop and implement the stakeholder-collaboration maturity model.
- Chapter 4 explains the resilience principles that improve through the collaboration of city stakeholders in the city resilience-building process. These principles were identified as result of a literature review.
- Chapter 5 describes the stakeholder-collaboration maturity model composed of five maturity stages for improving the collaboration between the local government and city stakeholders. The stakeholders that need to be involved, the policies that need to be implemented, and the indicators for evaluating the policies at each maturity stage are explained.
- Chapter 6: describes the case studies carried out to implement the stakeholder-collaboration maturity model.
- *Chapter 7*: highlights the main conclusions and the limitations of this research, and proposes future areas of research.

State of the Art

This section reviews the literature on city resilience and existing frameworks, standards, and maturity models for building city resilience. This research posits that building city resilience encompasses a holistic approach that integrates the efforts of different city stakeholders in the resilience-building process.

The literature on city resilience emphasizes the need to involve the different city stakeholders in the resilience-building process and the critical role of the local governments in promoting their involvement. However, existing frameworks for building city resilience lack to provide guidance on how the local governments can improve the collaboration with city stakeholders throughout the resilience-building process. In view of this gap, this research presents a stakeholder-collaboration maturity model with a sequence of stages and policies for the local governments to use as a reference to improve progressively the collaboration with city stakeholders.

2.1 City resilience

Nowadays, the majority of the world's population live in cities and, according to projections, this number will increase over the coming decades (100 Resilient Cities, 2016). A city is defined as a set of infrastructures, other structures, and buildings that create an environment to serve a population living within a relatively small and confined geographic area (Kreimer et al., 2003).

Accelerated globalization has dramatically increased the complexity and unpredictability of disaster risks that affect cities (Bach et al., 2010). As cities continue to grow, they face an increasing variety of challenges ranging from short-term disasters such as floods, droughts, and earthquakes, to long-term disasters such as climate change (Godschalk, 2003, Prior & Roth, 2013). The theoretical debate about city resilience began to be addressed in spatial planning in the 1990s in order to provide solutions for managing the resilience of the urban system as a whole and for coping with natural disasters in a comprehensive approach (Taşan-Kok et al., 2013). The emergence of resilience as a driver of urban policy resulted in a more integrated, multi-disciplinary and open planning system, one that views multi-stakeholder collaboration central to the planning process (Collier et al., 2013).

The concept of city resilience is interchangeably used with the term of urban resilience to emphasize the capacity of a city to adapt to short-term disasters and to long-term disasters that affect a city on a day-to-day basis (Spaans & Waterhout, 2017, Toubin et al., 2014). By addressing both short-term and long-term disasters, a city becomes able to respond to adverse events and is overall better equipped to deliver basic functions (Meerow et al., 2016, Spaans & Waterhout, 2017). The concept of city resilience has been applied in many different disciplines (such as climate change, disaster risk reduction, or planning). Yet there is a lack of a widely accepted definition on city resilience (Olazabal, 2017).

The United Nations International Strategy for Disaster Reduction (UNISDR) defines resilience as *“the ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely*

and efficient manner, including through the preservation and restoration of its essential basic structures and functions (UNISDR, 2007). Furthermore, the 100 Resilient Cities organization established by the Rockefeller Foundation for improving resilience in cities defines urban resilience as “the capacity of individuals, communities, institutions, business, and systems within a city to survive, adapt, and grow no matter what kinds of chronic stresses and acute shocks they experience” (100 Resilient Cities, 2016).

With regards to the disaster resilience literature, different definitions of city resilience can be found (Malalgoda et al., 2013). Toubin et al. (2014) defines resilient cities as those cities that use the right tools, assets and skills to deal with impacts and are able to resist, absorb and adapt to efficiently recover from the effects. Furthermore, according to Godschalk (2003), building a resilient city goes beyond changing land use and physical facilities. It must also build the capacity of the multiple involved communities to anticipate and respond to disasters. In this vein, the public and private organizations of a resilient city need to plan ahead and act spontaneously. Furthermore, the city needs to have a strong central governance, private sector, and nongovernmental institutions that recognize that the quest for resilience is an ongoing long-term effort (Godschalk, 2003).

Despite the variety of definitions of city resilience, the definitions are rather vague with respect to what constitutes an urban area or a city (Campbell et al., 2004). Actually, city resilience and community resilience are two terms that are often conflated in the disaster resilience literature (Murphy & Jennex, 2006). Whereas cities can be understood as politically defined administrative divisions such as municipalities, towns and cities, communities refer to neighborhoods and other types of socially bounded entities (Murphy & Jennex, 2006, Norris et al., 2008).

Following, a set of studies that define community resilience are presented. Chalfant & Comfort (2015, p. 13) define community resilience as “building capacity for sharing information, exchanging knowledge among responsible actors as a basis for informed action, providing timely feedback to update community threat assessments, and monitoring emerging needs and opportunities for action”. Furthermore, Ross & Berkes

(2014) define community resilience as “*the existence, development, and engagement of community resources by community members to thrive in an environment characterized by change, uncertainty, unpredictability, and surprise*”.

City resilience and community resilience definitions emphasize that the resilience of a system cannot be found on the level of the system (city) alone, but it also depends on the capacity of the stakeholders to prevent, prepare, respond, and recover from disasters (UNISDR, 2007, Chalfant & Comfort, 2015). Within a city, the involvement of the stakeholders in the resilience-building process maximizes local capacities and takes advantage of available resources (Oxley, 2013). Cities act as important nodes that connect local, regional, national and international networks and therefore, collaboration between different levels of governance is a prerequisite to build the resilience of cities (Prior & Roth, 2013).

However, strategies to build city resilience cannot be reduced to the actions carried out by the governments (Toubin et al., 2014). Strategies to build city resilience are most effective when they are not imposed top-down by the government, but are based on a shared understanding with stakeholders (Singh-Peterson et al., 2015). From all tiers of government (national, regional, and local), the role and actions of the local government in making cities resilient are predominantly critical (Malalgoda et al., 2013). The local government is the institutional level closest to the citizens and it plays the first role in attending to their needs (Kernaghan & da Silva, 2014). Furthermore, the local government has the capacity to obtain the specific local knowledge and build close connections with city stakeholders (Prior & Roth, 2013).

2.2 City stakeholders

In the disaster management field, the approach to building city resilience has gradually moved beyond the classic top-down bureaucratic model to become a more dynamic and flexible network model that facilitates multi-stakeholder collaboration (Cavallo & Ireland, 2014, Waugh & Streib, 2006). The success of building city resilience is determined by the extent to which city stakeholders are involved in the resilience-building process (Kapucu et al., 2010, McEntire

2007). City stakeholders are the individuals, groups or organizations within a city who can affect or are affected by the resilience-building process such as the entities and departments from the local government, emergency services, volunteer organizations, citizens, media, academic, educational and scientific entities and private and public companies (Malalgoda et al., 2014, White et al., 2014) (see Figure 2.1). It is further observed that none of these city stakeholders can act in isolation and that the local government has a key role in the involvement of stakeholders in the resilience-building process (Malalgoda et al., 2013).



Figure 2.1: City stakeholders.

Based on an analysis of the resilience literature, the city stakeholders and their roles in the resilience-building process were identified. Following, the description of the different groups of stakeholders and their roles are presented.

2.2.1 Local government

From all levels of governments (i.e. national, regional and local) the role of the local governments in the resilience-building process is considered predominantly critical as they are the closest governmental body to the citizens (Malalgoda et al., 2013). The local government entails the different departments of the City Council and is responsible for providing a strategic planning vision to better prepare the city to respond to disaster risks and for ensuring the continuity of service in the city (UNISDR, 2015a).

The local government needs to provide appropriate funding, support and assistance to ensure disaster prevention and response (FEMA, 2011). Furthermore, the local government needs to interact with other city stakeholders in daily life activities and bridge for communications to coordinate tasks and administration related to disaster management affairs (Chou & Wu, 2014).

2.2.2 Emergency services

The emergency services involve the entities in charge of managing emergencies and disasters such as civil protection units and managers, as well as entities that are on the front line of emergencies such as police, firefighters, ambulances, and health care services (Kapucu et al., 2010, Weichselgartner & Kelman, 2014). The role of the emergency entities is to provide security and safety to citizens by reducing, preparing and responding to disaster risks (Australian Government, 2011). Furthermore, the emergency services play an important role by providing public education, alert and warning systems, and disaster plans (FEMA, 2011).

2.2.3 Volunteer organizations

A number of voluntary sector organizations exist which have building resilience and humanitarian aid as part of their core remit (such as community emergency response organizations) (FEMA, 2011). Other voluntary sector groups, including social care and faith groups, youth organizations, and day centers adapt their roles to meet the needs of communities faced by disasters.

Volunteer organizations can be funded by governments, business or private persons and can provide organizational as well as material support (such as volunteering opportunities or food and shelters in of disasters). Furthermore, volunteer organizations often emerge spontaneously in response to disasters of varying scale and type (Carmin et al., 2012, Whittaker et al., 2015).

2.2.4 Critical Infrastructures (CIs)

CIs are defined as an asset or system of a city which is essential for the maintenance of vital societal functions, health, safety, security, economic or social well-being of people, and the disruption or destruction of which would have a significant impact in the city (EU Commission, 2005). CIs provide essential needs to the citizens such as health care, transportation, telecommunications, water, energy etc. (Stewart et al., 2009), so their adequate functioning in case of disasters is crucial (Cavallo & Ireland, 2014, Tyler & Moench, 2012).

2.2.5 Academic, educational and scientific entities

Academic, educational and scientific entities include schools, universities and research centers. They contribute to increasing the knowledge and the development of methodologies to better mitigate and prepare for, respond to, and recover from disasters and build city resilience (Cavallo & Ireland, 2014). Furthermore, educational institutions, such as schools and universities, can promote resilience and raise awareness of disaster management among children and communities (Oktari et al., 2015, UNISDR, 2015a).

2.2.6 Citizens

Citizens play a vital role in initiating action by advocating for change and influencing decisions from the government (Kernaghan & da Silva, 2014, UNISDR, 2015a). Citizens, in special vulnerable ones (such as citizens that live in risk prone areas, persons with disabilities, poor people, and migrants) need to

be empowered to act responsibly in the resilience-building process (Weichselgartner & Kelman, 2014, Whittaker et al., 2015).

2.2.7 Media

The media such as the local newspapers and radio and television channels is in charge of disseminating hazard information and early warning measures in an easy and accessible manner (Kapucu, 2008). Furthermore, social media and information communication technologies contribute to the dissemination of information on disasters, plans in place and protection measures to city stakeholders (Cavallo & Ireland, 2014, Prior & Roth, 2013).

2.2.8 Public and private companies

Public and private companies entail consultancies, insurance companies, and businesses within the city. Companies need to be engaged in awareness raising and training programs so that they are able to prepare and respond to disasters (Australian Government, 2011, FEMA, 2011). Furthermore, companies and business provide resources, sponsorship, guidance and workforce to prepare, respond, and recover from disasters (Malalgoda et al., 2013).

2.3 Frameworks for building city resilience

Building city resilience is a cooperative process that requires the active and coordinated participation of different city stakeholders, including governmental and non-governmental agencies, the private sector, volunteers and citizens (Aedo et al., 2010, Waugh & Streib, 2006). The literature on city resilience provides a set of frameworks that emphasize the critical role of local governments and the need to involve different stakeholders in the resilience-building process (Jabareen, 2013). The following sections describe the most popular frameworks aimed at enhancing resilience in cities. Furthermore, the gaps and limitations of city resilience frameworks with regards to the involvement of stakeholders in the city resilience-building process are described.

2.3.1 Academic frameworks

On the basis of existing studies of resilient cities, Godschalk (2003) recommends a series of actions for improving current hazard mitigation policy and practice for building resilient cities. Godschalk (2003) proposes that in addition to traditional physical system hazard mitigation functions, a resilient city would monitor vulnerability reduction, build distributed hazard mitigation capability, develop broad hazard mitigation commitment, operate networked communications, adopt recognized equity standards, assist threatened neighborhoods and populations, and mitigate business interruption impacts (Godschalk, 2003).

In the same vein, Jabareen (2013) provides a conceptual framework (Resilient City Planning Framework) that addresses the question of what cities and their urban communities should do in order to move towards a more resilient state in the future. The Resilient City Planning Framework is a network of four interlinked factors (economic, social, spatial, and physical) that together, provide an understanding of the city resilience.

With regards to building resilience towards climate change, Tyler et al. (2010) present a framework that includes characteristics of urban systems, the agents (people and organizations) that depend on and manage those systems, institutions that link systems and agents, and patterns of exposure to climate change. The viability of the framework is demonstrated through examples from resilience planning activities undertaken in 10 cities across Asia.

Furthermore, Desouza (2013) takes a step forward and proposes a conceptual resilience framework to develop a more holistic approach to designing, planning, and managing for resilience by including an evaluation of cultural and process dynamics within cities as well as their physical elements. The framework looks at the stressors that impact a city, the outcomes of stress, and three sets of interventions (designing, planning, and managing) for building resilient cities (Desouza & Flanery, 2013).

2.3.2 The Hyogo Framework

The Hyogo Framework for Action (HFA) 2005-2015: *Building the Resilience of Nations and Communities to Disasters* was the first plan to reduce losses stemming from natural hazards (UNISDR, 2005). This framework addresses the roles of state, regional, and international organizations and calls, on civil society, academia, volunteer and community organizations and the private sector to join resilience-building efforts. Furthermore, the HFA identifies five priority actions to promote a strategic and systemic approach to reducing vulnerabilities, threats and risks, thereby increasing nations' and communities' resilience to disasters (de Carvalho et al., 2016). Following the five priority actions are presented:

- Priority Action 1: “Ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation”. Also known as the political dimension, it is focused on building a framework that contains incentives and laws, aimed at reducing disaster risk.
- Priority Action 2: “Identify, assess and monitor disaster risks and enhance early warning”.
- Priority Action 3: “Use knowledge, innovation and education to build a culture of safety and resilience at all levels”.
- Priority Action 4: “Reduce the underlying risk factors.”
- Priority Action 5: “Strengthen disaster preparedness for effective response at all levels”.

The HFA priority actions are linked to tasks that serve as guidance for carrying out the necessary steps for completion of each action (UNISDR, 2007). The tasks can be addressed as independent activities, which usually involve a series of steps such as planning, consultations and reports. Although most of the priority actions and related tasks need not be performed in a particular order, it is important to have the tasks of Action Priority 1 under way from an early stage, because they provide the basis for the others, ensuring the political and institutional support from the government and political leaders (de Carvalho et al., 2016).

2.3.3 The Sendai Framework

The HFA was valid until 2015, when the successor framework, the Sendai Framework for Disaster Risk Reduction 2015-2030, was developed. The Sendai Framework calls for the reduction of disaster risks through an “all-of-society” and “all-of-State institutions” engagement approach that emphasizes the important role that local governments and communities play in reducing vulnerabilities and enhancing community resilience (Kwok et al., 2016). The Sendai Framework recognizes that governments have the leadership, regulatory and coordination capacities to reduce disaster risk and defines four new priorities for reducing disaster risks:

- Priority 1: Understanding disaster risk.
- Priority 2: Strengthening disaster risk governance to manage disaster risk.
- Priority 3: Investing in disaster risk reduction for resilience.
- Priority 4: Enhancing disaster preparedness for effective response and to “build back better” in recovery, rehabilitation and reconstruction.

While the Sendai Framework recognizes the leading, regulatory and coordination role of governments, it emphasizes that governments should engage with relevant stakeholders, including women, children and youth, persons with disabilities, poor people, migrants, indigenous peoples, volunteers, the community of practitioners and older persons in the design and implementation of policies, plans standards. It is therefore necessary that the public and private sectors and civil society organizations, as well as academia and scientific and research institutions, work more closely together and to create opportunities for collaboration, and for business to integrate disaster risk into their management practices (UNISDR, 2015a).

2.3.4 UNISDR’s Ten Essentials and the Disaster Resilience Scorecard

The Ten Essentials for Making Cities Resilient are developed in order to accelerate implementation of the Sendai Framework for Disaster Risk Reduction

at local level. The Ten Essentials map directly against the Sendai priorities of action and its indicators for monitoring actions on disaster risk reduction. The Ten Essentials are independent and should be part of the overall disaster risk reduction planning process.

- Organize for Disaster Resilience: Put in place organization and coordination to understand and reduce disaster risk, based on participation of citizen groups and civil society.
- Strengthen Financial Capacity for Resilience: Assign a budget for disaster risk reduction and provide incentives for communities to invest in reducing the risks they face.
- Identify, Understand and Use Current and Future Risk Scenarios: Maintain up-to-date data on hazards and vulnerabilities. Prepare risk assessments and use these as the basis for urban development plans and decisions.
- Increase Infrastructure Resilience: Invest in and maintain critical infrastructure that reduces risk, such as flood drainage, adjusted where needed to cope with climate change.
- Strengthen Institutional Capacity for Resilience: Assess the safety of all schools and health facilities and upgrade these as necessary.
- Pursue Resilient Urban Development and Design: Apply and enforce realistic, risk compliant building regulations and land-use planning principles. Identify safe land for low-income citizens.
- Understand and Strengthen Societal Capacity for Resilience. Ensure that education programs and training on disaster risk reduction are in place in schools and local communities.
- Safeguard Natural Buffers to Enhance Ecosystems' Protective Functions: Protect ecosystems and natural buffers to mitigate floods, storm surges and other hazards to which your city may be vulnerable.

- Ensure Effective Disaster Response: Install early warning systems and emergency management capacities in your city and hold regular public preparedness drills.
- Expedite Recovery and Build Back Better: After any disaster, ensure that the needs of the affected population are placed at the center of reconstruction, with support for them to design and help implement recovery measures.

Together with the UNISDR's *Making Cities Resilience Campaign's Ten Essentials*, the Disaster Resilience Scorecard provides a set of assessments to allow cities to understand how resilient they are to natural disasters (UNISDR 2015b). The scorecard is structured in ten sections that have been designed to add a level of detail to the ten essentials, making them more specific and tangible. The Scorecard allows a numerical and visual assessment of the status of an area of activity to track progress, to provide a perspective on a city's total disaster resilience posture, while also identifying gaps in plans and provisions (UNISDR, 2015a).

2.3.5 The City Resilience Framework (100 Resilient Cities)

As part of its mission to promote the well-being of humanity around the world, in 2013 the Rockefeller Foundation adopted a programme focusing on urban resilience. The 100 Resilient Cities Programme is dedicated to helping cities around the world become more resilient to the physical, social, and economic challenges that increasingly affect the 21st century. The 100 Resilient Cities initiative defines cities as complex and dynamic entities that face a range of challenges. At any point city stakeholders such as individuals, households, businesses and voluntary organizations may be responding to a number of challenges, such as low income, poor health, social isolation, trading difficulties etc. These challenges also affect the extent to which city stakeholders may become vulnerable in a disaster situation. Taking these challenges as a basis, the 100 Resilient Cities programme provides the City Resilience Framework for assessing and addressing resilience across this wide spectrum of stresses (Rockefeller Foundation & ARUP, 2014).

The City Resilience Framework, as presented in Figure 2.2, distinguishes between four categories (inner ring) and twelve indicators (outer ring) (Rockefeller Foundation & ARUP, 2014). The four categories are considered basic elements available to a greater or lesser extent in all local systems. They cover the health and wellbeing of individuals (people); infrastructure & environment (place); economy and society (organization); and, finally, leadership and strategy (knowledge). The twelve indicators have been found to be critical in cities dealing with disasters and describe the fundamental attributes of a resilient city.

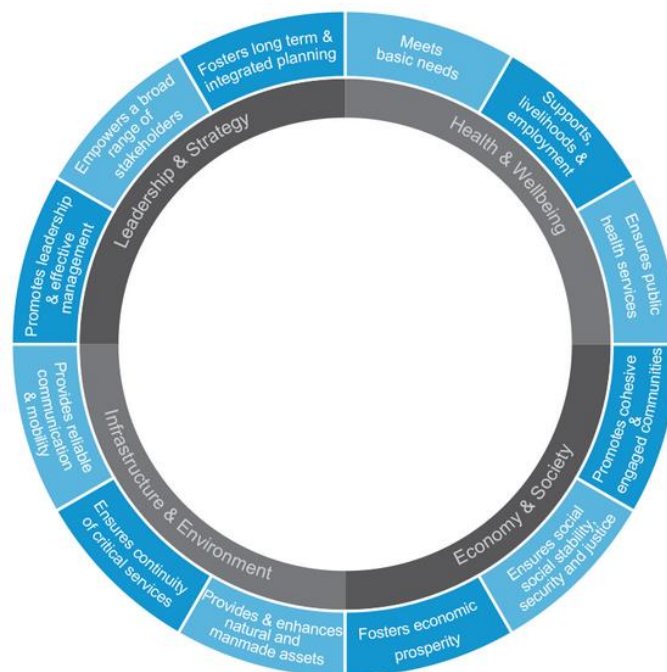


Figure 2.2: City Resilience Framework
(Source: Rockefeller Foundation & ARUP, 2014)

2.3.6 Limitations of existing frameworks

On the one hand, frameworks for building city resilience provide a list of independent actions to use as checklist to improve resilience (Weichselgartner & Kelman, 2014). However, these frameworks lack to provide a roadmap with the temporal sequence of actions that the local governments should put into

application as a function of the current situation of a city (Cavallo & Ireland, 2014).

On the other hand, existing frameworks emphasize the crucial role of governments in building city resilience and call for a holistic and multi-stakeholder approach where city stakeholders need to be involved in the resilience-building process (Shaw, 2012). Currently, however, local governments and organizations with the responsibility for building resilience encounter challenging to collaborate with the different city stakeholders in the resilience-building process and how to support stakeholders' engagement (Prior & Roth, 2013, White et al., 2014).

Furthermore, not all stakeholders have the same responsibilities with regards to the resilience-building process (Singh-Peterson et al., 2015). In this vein, the above mentioned frameworks do not help local governments to identify which policies should be implemented to involve the different city stakeholders in the city resilience-building process (Cavallo & Ireland, 2014, Jabareen, 2013). In this context, models that help local governments to involve different stakeholders at the most appropriate time and in a manner that contributes to the resilience-building process need to be developed (Whittaker et al., 2015).

2.4 International standards

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies. International standards state specifications and guidelines for organizations to improve the management of processes in different areas. In the field of disaster resilience, a set of international standards aimed at helping organizations to build resilience have recently been developed. Following, existing international standards in the disaster resilience field are described. Furthermore, the limitations of existing international standards are presented.

2.4.1 Existing international standards

The ISO 22397:2014 (*Societal security - Guidelines for establishing partnering arrangements*) provides guidelines for establishing partnering arrangements among organizations to manage multiple relationships for events impacting on societal security. It incorporates principles and describes the process for planning, developing, implementing and reviewing partnering arrangements.

The ISO 22325:2016 (*Security and resilience - Emergency management - Guidelines for capability assessment*) provides guidelines for an organization in assessing its capacity to manage prevention, preparedness, response and recovery before, during and after potentially disruptive events. It includes an assessment model with eight indicators (*leadership, resource management, information and communication, risk management, coordination and cooperation, emergency management planning, exercise programme and incident management system*) that explains how to plan, collect, analyze and report in order to enable the organization to identify opportunities for improvement. This ISO standard is intended to be used by organizations responsible and accountable for emergency management.

The ISO 22316:2017 (*Security and resilience - Guidelines for organizational resilience*) provides guidance to enhance organizational resilience for any size or type of organization in any industry or sector. However, this standard does not promote uniformity in approach across all organizations, as specific objectives and initiatives are tailored to suit an individual organization's needs.

More specifically targeted at the volunteering community, the ISO 22319:2017 (*Security and resilience - Community resilience - Guidelines for planning the involvement of spontaneous volunteers*) provides guidelines for planning the involvement of spontaneous volunteers (SVs) in incident response and recovery. It is intended to help organizations establishing a plan to consider whether, how and when SVs can provide relief to a coordinated response and recovery for all identified hazards. This standard is applicable to all types and sizes of organizations that are involved in the planning for, and management of, SVs (e.g. local, regional, and national governments, statutory bodies, international and

non-governmental organizations, businesses and public and community groups).

2.4.2 Limitations of existing international standards

There is a set of international standards to build resilience of organizations across different sectors. According to the approach taken by ISO standards, in order for an organization to reach compliance with a standard, the organization needs to show evidence about every single defined requirement (Antunes et al., 2014). However, international standards lack to establish the sequential steps that need to be followed to implement the defined requirements in a temporal order. Furthermore, existing international standards do not provide organizations with the objectives that should be achieved to implement the requirements in an incremental way along an established improvement roadmap (Antunes et al., 2014).

2.5 Maturity models

The concept of maturity is being used to describe a stage where an organization is in perfect conditions to achieve its objectives (Backlund et al., 2014). To reach a desired stage of maturity, an evolutionary path of transformation from an initial to a target stage of progression needs to be followed (Wendler, 2012). A maturity model is defined as a structured sequence of stages that describes the evolution of an effective process at different stages of development, from an initial stage to a more advanced stage (Becker et al., 2009, Pöppelbuß & Röglinger, 2011).

Based on the assumption of predictable patterns of evolution, maturity model provides an anticipated and logical roadmap for organizations to identify the goals to be achieved at each stage and the temporal order of the polices to progress from one stage to another (de Carvalho et al., 2016). In this vein, advancing through the evolution path indicates that organizations are improving their capabilities step by step (Becker et al., 2009).

According to the maturity model methodology, for an organization to reach a certain maturity stage, it is essential that it meets a particular set of requirements of that stage (de Carvalho et al., 2016). Furthermore, it should be taken into account that organizations should follow the sequence of the proposed stages from the lowest to the higher maturity stages, instead of achieving all maturity stages at once or skipping an stage and jumping to the next one (Lee & Kwak, 2012).

Maturity models are however, subject to critiques with regards to their validity and usefulness (Albliwi et al., 2014). Maturity models require a considerable amount of time and effort to implement and often need a major shift in culture and attitude within organizations (Backlund et al., 2014). Although there may be organizations that do not achieve the most mature stage, the main purpose of maturity models is to enable continuous improvement (de Carvalho et al., 2016). Furthermore, it should be taken into account that the ultimate contribution of maturity models is to support organizations to prioritize actions in order to follow a logical path for progressive development even if they do not reach the most advanced maturity stage (Albliwi et al., 2014, Jude et al., 2017). Maturity models, thus, support organizations from a strategic approach providing the basis for any assessment and to point out the logical path for progressive development (Backlund et al., 2014).

2.5.1 Existing maturity models

Maturity models have been extensively studied and utilized in multiple engineering domains as an instrument for continuous improvement (Wendler, 2012). Maturity models generate awareness and deep understanding of the analyzed process and its complexity (Antunes et al., 2014). Following the success of the Capability Maturity Model for Software, there has been significant interest in this field across multiple areas, both from an academic and professional point of view (Antunes et al., 2014).

In the context of disaster management, previous maturity models have been developed for improving the performance of organizations. However, these maturity models are very diverse and have very different purposes. On the one

hand, Weyns et al., 2010 present a maturity model (IT dependability in Emergency management maturity model) to improve communication and information technology management between emergency managers, information technology management, and users within an organization. On the other hand, Santos et al. (2011) present a maturity model for the use of information technologies in disaster response organizations. The presented maturity models aim at enhancing the capability of organizations to adopt technologies but lack to foster a culture of collaboration between different organizations.

In line with this, Mäkelä & Virrantaus (2013) propose a maturity model to enhance the level of collaboration, situational awareness, and information sharing among disaster management organizations. While this maturity model is designed to improve collaboration among professional disaster management organizations, it lacks to foster collaboration among the wide variety of stakeholders such as citizens, volunteers and public and private companies that contribute to improving the overall resilience of a city.

Another maturity model that has been developed is the SMR maturity model. The SMR maturity model is a tool for reflection and guidance for building resilient cities developed within the Smart Mature Resilience European project (Smart Mature Resilience, 2016). The approach of the SMR maturity model is to build city resilience from a holistic and multi-governance approach focusing on the potential linkages across local, regional, national and international stakeholders and networks. The SMR maturity model does not view cities as isolated entities, but rather as interconnected and interdependent units, in the similar situation of vertebrae as interconnected and interdependent parts of a backbone. The SMR maturity model provides policies to be implemented by cities classified according to different resilience dimensions such as *infrastructure and resources, cooperation, leadership and governance, and preparedness*. According to the approach of the SMR maturity model, cooperation among stakeholders is one of the requirements for building up the overall city resilience level.

2.5.2 Limitations of existing maturity models

Maturity models provide a roadmap for organizations to evaluate, plan and implement a systematic and effective approach to increase the performance of a given process and reach more mature stages (Albliwi et al., 2014, Santos et al., 2011). The approach developed in maturity models can contribute to improving stakeholders' collaboration in the city resilience-building process. Currently, however, existing maturity models are not specifically designed for the local governments to improve progressively the collaboration with city stakeholders and to involve different city stakeholders in the resilience-building process.

2.6 Contribution of this research

During the last decade, devastating floods, earthquakes, and volcanic eruptions among other disasters have driven governments throughout the world to turn their attention increasingly to building city resilience (Bach et al., 2010). The literature on city resilience emphasizes the need of collaboration between the government and stakeholders at the local level to pool existing resources and capacities to build resilience (Oxley, 2007). In this vein, building city resilience requires the collaboration of a wide variety of city stakeholders including the local government, emergency services, citizens, volunteer organizations and public and private companies (Cavallo & Ireland, 2014, Oxley, 2013). Currently, however, local governments face challenges to bolster the capacity of public, private, and civic sectors and collaborate with them in the resilience-building process (Bach et al., 2010).

Although there is a set of frameworks aimed at building city resilience, frameworks specifically aimed at enhancing collaboration with stakeholders in the resilience-building process remain undeveloped (Prior & Roth, 2013, Singh-Peterson et al., 2015). In this vein, there is little understanding on how local governments can support the engagement of the different city stakeholders in a manner that contributes to the resilience-building process (Cavallo & Ireland, 2014, Weichselgartner & Kelman, 2014).

Given this gap, frameworks that help local governments to understand and assess how to engage stakeholders at the most appropriate time and in a manner that contributes to the resilience-building process need to be developed (Whittaker et al., 2015). To reach a desired stage of maturity within an organization, an evolutionary path of transformation from an initial to a target stage of progression needs to be followed (Wendler, 2012). In this context, maturity models provide a roadmap to identify, evaluate, and implement policies in a systematic way (Wendler, 2012).

The contribution of this research is the development of a stakeholder-collaboration maturity model specifically designed to improve progressively the collaboration between the local government and city stakeholders in the resilience-building process. The stakeholder-collaboration maturity model provides local governments with a defined roadmap to identify, evaluate, and implement policies to improve the collaboration with the different city stakeholders that need to be involved in the resilience-building process. Furthermore, the stakeholder-collaboration maturity model describes a sequence of maturity stages and policies, the stakeholders that need to be involved in the implementation of the policies and the indicators that help to assess the implementation of the policies.

The stakeholder-collaboration maturity model presented in this research was developed in close collaboration with six European cities committed to improving their resilience level. Furthermore, two case studies were carried out in two cities at different maturity stages to verify the sequence of stages and policies defined in the stakeholder-collaboration maturity model.

3 Research Methodology

This section presents the methodology carried out in order to develop this research. The methodology is composed of three main phases: (1) conceptualization, (2) development of the stakeholder-collaboration maturity model, and (3) implementation of the stakeholder-collaboration maturity model. In each phase different research methods were applied.

First, a literature review was carried out within the conceptualization phase in order to identify existing research studies, the research gap, and the research questions. Second, a Delphi study, semi-structured interviews, review of resilience strategies, and a survey were carried out with multidisciplinary experts in the disaster resilience field in order to develop the stakeholder-collaboration maturity model. Finally, two case studies were carried out in two cities that are at different maturity stages. Following, this chapter explains the general characteristics of the used research methods and it describes the application of the methods in each of the phases.

3.1 Research methodology

The research methodology needs to be suitable in relation to the research topic, research objectives, and the desired results. This research aims at developing a stakeholder-collaboration maturity model for improving progressively the collaboration of the local government with the city stakeholders in the resilience-building process. During the development phase, the methodologies that were applied consisted of reviewing the disaster resilience literature and gathering knowledge from experts and practitioners in the field of disaster resilience.

The methodology used in this research consists of three main phases: (1) conceptualization and determination of the research questions, (2) development of the stakeholder-collaboration maturity model, and (3) implementation of the stakeholder-collaboration maturity model. In each phase, combinations of different research methods were applied: (1) Literature review, (2) Delphi study, (3) Semi-structured interviews and review of resilience strategies, (4) Survey, and (5) Case study. Figure 3.1 resumes the research methodology including the research methods, the results, and the published papers in each step. Following, the phases carried out in this research are explained in detail.

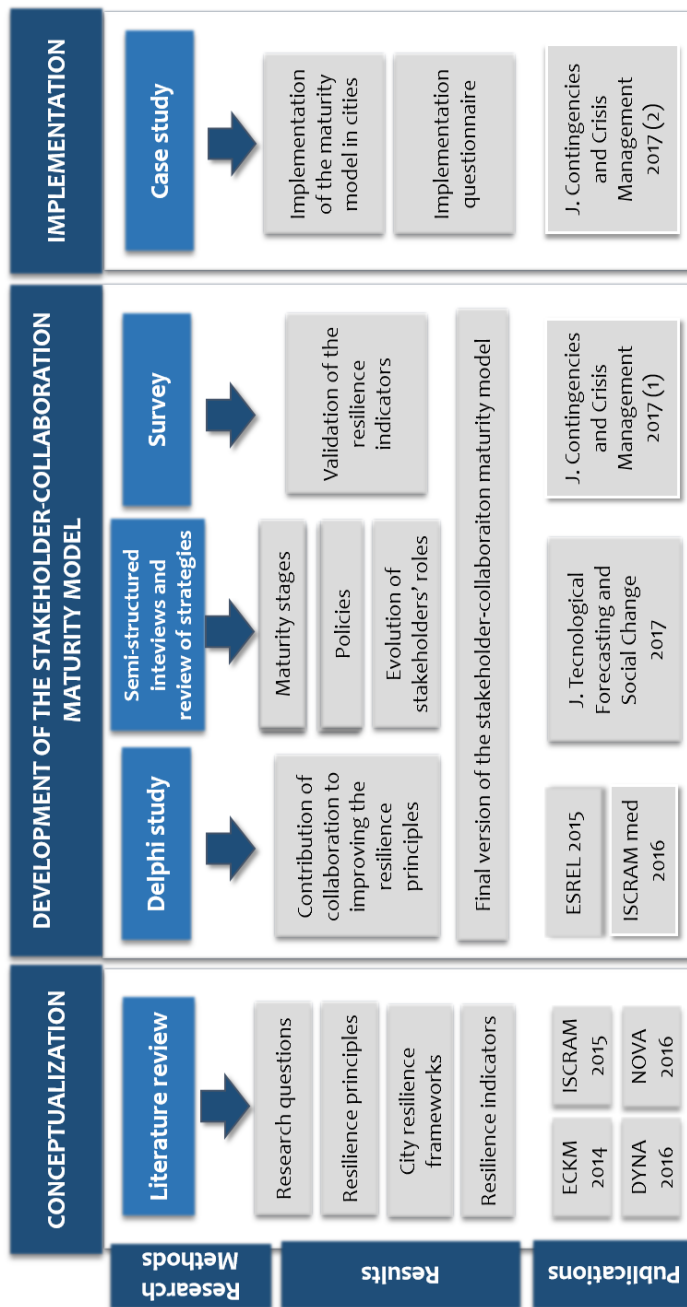


Figure 3.1: Research methodology.

3.2 Conceptualization phase: Literature review

The literature review was chosen as a research method during the conceptualization phase to analyze the existing literature, research gaps, and establish the research objectives. A literature review is an analysis of the relevant available research and non-research literature on the topic being (Hart, 1998). It allows on the one hand, to analyze the existing literature in the field of study and to analyze the possible contribution of the research. On the other hand, it assists on defining the context in which the study will be established and narrowing down the scope of the research into a manageable project (Webster & Watson, 2002).

The objective of this literature review was to identify research studies and frameworks that deal with city resilience development. The first step to carry out a literature review is to define a set of keywords and search for research studies that contain those keywords in different databases. In the case of this research, the following keywords: *city*, *resilience*, *disaster management*, and *collaboration* were searched in three different databases (Emerald, Scopus and Science direct). These databases were selected because they index a large number of journals in the social science research field (Guz & Rushchitsky, 2009).

The next steps consisted of identifying the articles that fitted in the scope of this research. Table 3.1 presents the steps followed to carry out the literature review and the number of research studies selected. The first step consisted of conducting a search with the defined combination of keywords in order to identify articles. The second step consisted of reviewing the articles to exclude the ones that were out of the scope of this study. For reviewing the articles, the title, the keywords, the abstract and the conclusions of the articles were analyzed. Based on this information, there were some articles that could be rapidly excluded, since they provided clear evidence that such articles were not related to the topic. Finally, the third step consisted of reading articles thoroughly in order to determine whether the paper would be included in the definitive list.

Table 3.1: Steps of the literature review.

STEPS	SEARCH DESCRIPTION AND CRITERIA	RESULTS
Step 1: Initial search	Database: Science Direct, Emerald and Scopus. Keywords: “resilience”, “city”, “disaster management” and “collaboration”. Search in: Title, Abstract & Keywords Type: Journal article Period of time: from 2005 to 2015	311
Step 2: Quality check	Review title, keywords, abstract and conclusions to exclude articles out of the scope.	192
Step 3: Review of full paper	Review full articles.	126

Based on the review of studies aimed at building city resilience, the objectives of this research were defined (see Chapter 1). Furthermore, as a result of the literature review, existing frameworks for building city resilience, the city stakeholders that need to be involved in the city resilience-building process and their roles were analyzed (see Chapter 2). In addition, the principles that can improve through stakeholder collaboration in the city resilience-building process were defined. These principles will be further explained in Chapter 4.

3.3 Development phase

The literature review resulted in the identification of four principles (*collaboration*, *awareness*, *preparedness*, and *learning*) that improve through the collaboration of stakeholders in the resilience-building process. These principles will be further explained in Chapter 4. Following the literature review, a Delphi study was carried out to evaluate the contribution of *collaboration* principle to *awareness*, *preparedness*, and *learning* principles. The Delphi study involved a group of multi-disciplinary and international experts in the disaster resilience field.

Afterwards, two rounds of semi-structured interviews were carried out to develop the stakeholder-collaboration maturity model. The first round of semi-structured interviews was carried out to determine the evolution of the collaboration of city stakeholders in the resilience-building process.

Furthermore, information on how the involvement of the different stakeholders during the city resilience-building process contributes to the improvement of *collaboration, awareness, preparedness, and learning* principles was obtained.

After the first round of interviews, strategic reports and plans of different cities were reviewed to identify the sequence of stages and the policies that need to be implemented to progressively improve the collaboration between the local government and city stakeholders. The second round of the semi-structured interviews was carried out to improve the stakeholder-collaboration maturity model and validate the sequence of stages and policies identified. Finally, a survey was carried out in order to validate indicators for evaluating the implementation of the policies in the stakeholder-collaboration maturity model.

3.3.1 Delphi study

Gathering knowledge from experts involved in disaster management organizations was necessary to assess the influence of *collaboration* principle in the improvement of *awareness, preparedness, and learning* principles. The Delphi method was an ideal methodology to achieve this as it is a method for structuring an effective communication process that allows a group of individuals, as a whole, to deal with a complex problem (Linstone & Turoff, 1975).

The Delphi method consists of multiple rounds of questionnaires that are sent to experts of the field. In the first round, a questionnaire is sent to the participants. After the experts provide their answers to the questionnaire, their answers are analysed and the mean of the group's ranking is provided to the participants (Skulmoski et al., 2007). The expectation is that each expert may reflect on their earlier answer and over time, some convergence may be obtained. The process is anonymous and is repeated until the stopping criterion is reached: for example, a fixed number of rounds have been completed or a consensus has been achieved. Delbecq et al. (1975) propose that two or three interactions need to be carried out to refine participant's answers.

The key elements of the Delphi method are the following (Linstone & Turoff, 1975):

- The anonymity of participants: experts express their opinions freely without fear of disagreeing with others. This reduces the confrontation and inhibiting effects that might occur among participants in face-to-face processes.
- Interaction: this allows experts to reconsider their answers based on the information they receive from other experts.
- Controlled feedback: a coordinator is responsible for organizing the exchange of information between the experts and for eliminating duplicate or irrelevant information.

Taking into account the characteristics mentioned above, we chose to carry out the Delphi study in this research. The objective of the Delphi study was to analyze the contribution of *collaboration* principle to improve *awareness*, *preparedness*, and *learning* principles in the resilience-building process. To do so, an exploratory round was carried out to examine the existence of a potential relationship between the *collaboration* principle to the improvement of the resilience principles (*awareness*, *preparedness*, and *learning*). Afterwards, a confirmatory round was carried out to assess this relationship (see Figure 3.2).

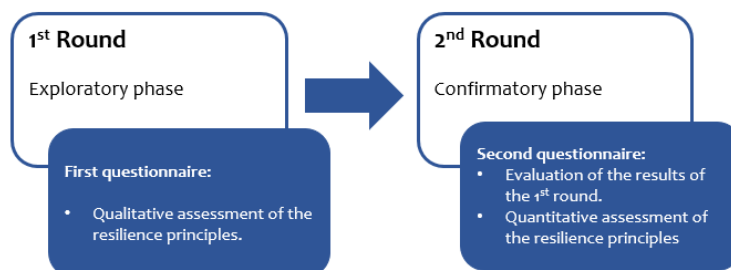


Figure 3.2: Rounds of the Delphi study.

Concerning the number of participants that should take part in the Delphi process, Delbecq et al. (1975) propose that the sample should be between ten and fifteen people in case the sample is homogeneous. On the contrary, if disparate participants are involved, Linstone and Turoff (1975) propose that four to five experts from each field are needed to perform the process.

In the Delphi study that was conducted in this research, 112 multidisciplinary experts closely related to the field of disaster management were invited to participate. Initially, 45 experts participated in the first round of the Delphi study. Finally, the second round of the Delphi study was completed by 30 experts. The final panel of participants that completed the two rounds was composed of 30 experts from 13 different countries and with four different backgrounds: seven stakeholders from civil protection, seven stakeholders from disaster management and planning, nine first responders, and seven academics and researchers (see Table 3.2).

Table 3.2: Participants in the Delphi study.

ORGANIZATION (N° OF PARTICIPANTS)	COUNTRY	BACKGROUND
IMAA-CNR Institute of Methodologies for Environmental Analysis (1)	Italy	Civil protection
ANCI Umbria (2)	Italy	Civil protection
Austrian Federal Ministry of Defense and Sports (1)	Austria	Civil protection
ANPAS Associazione Nazionale Pubbliche Assistenze (2)	Italy	Civil protection
Security department from the Basque Government (1)	Spain	Civil protection
Argonne National Laboratory (1)	USA	Disaster management/ planning
Emergency Response and Meteorology of the Basque Country (1)	Spain	Disaster management/ planning
South-Savo Regional Fire Service (1)	Finland	Disaster management/ planning
Province of Terni (1)	Italy	Disaster management/ planning
Swedish Civil Contingencies Agency (1)	Sweden	Disaster management/ planning
Westpac Group (1)	Australia	Disaster management/ planning
Basque Country Security Department (1)	Spain	Disaster management/ planning
Health Emergencies of Andalucía (1)	Spain	First responder
Polish Main School of Fire Service (2)	Poland	First responder

ISAR (1)	Germany	First responder
Austrian Research institute of the Red Cross (1)	Austria	First responder
United Nations - Office for the Coordination of Humanitarian Affairs (1)	Switzerland	First responder
Fire Fighter Catalonia (1)	Spain	First responder
Fire Ecology and Management Foundation Pau Costa (1)	Spain	First responder
Police Academy of the Netherlands (1)	Netherlands	First responder
Università degli Studi G. d'Annunzio Chieti e Pescara (1)	Italy	Academic/Researcher
New Jersey Institute of Technology (2)	USA	Academic/Researcher
University of Canterbury (1)	New Zealand	Academic/Researcher
Norwegian Defense Research Establishment (1)	Norway	Academic/Researcher
SPRINT - University of Udine (2)	Italy	Academic/Researcher

In the Delphi study carried out in this research, *awareness*, *preparedness*, and *learning* principles were presented based on a series of statements. In the first round, the participants in the Delphi were asked via an online questionnaire to rate their degree of agreement on the contribution of the *collaboration* principle to the improvement of each statement. A four level Likert-type scale (strongly agree, agree, disagree, strongly disagree) was used to evaluate how the collaboration between stakeholders helps to improve *awareness*, *preparedness*, and *learning* principles. Participants had also the opportunity to answer 'Don't know'. The questionnaire of the first round of the Delphi can be found in Appendix A. After analysing the results obtained, participants received a report with a summary of the results obtained during the first round and were asked to give their feedback. This report gave participants the opportunity to reassess their answers and try to seek consensus.

Afterwards, a second round of the Delphi study was carried out. This time, experts were asked to assess in an online questionnaire the influence of each statement using a ten-point Likert-type scale (ranging from no influence/very low influence to strong influence). The questionnaire of the second round of the Delphi can be found in Appendix B. As result of the second round of the Delphi

study, the contribution of *collaboration* principle to the improvement of *awareness*, *preparedness*, and *learning* principles was assessed.

3.3.2 Semi-structured interviews and review of resilience strategies

After confirming the contribution of *collaboration* principle to improving the *awareness*, *preparedness*, and *learning* principles, two rounds of interviews were carried out to gather information on the evolution of the resilience principle in different cities. The objective of interviews is to gain information on a particular topic or a particular area to be researched and to gain rich information about the experiences of individuals (DiCicco-Bloom and Crabtree, 2006). Kvale (2007) defines the qualitative research interview as “*an interview, whose purpose is to gather descriptions of the life-world of the interviewee with respect to interpretation of the meaning of the described phenomena*”. In the case of this research, the interviews were semi-structured and allowed asking open-ended questions to respondents.

In total, six semi-structured interviews were carried out with ten representatives from European cities (Bristol and Glasgow in the UK, Donostia/San Sebastián in Spain, Kristiansand in Norway, Rome in Italy, and Vejle in Denmark). These cities were selected because they are in different geographical locations, they suffer different threats, and they have different cultures and governments. At the same time, the cities of Bristol, Glasgow, Rome and Vejle had been selected by the 100 Resilient Cities network for showing a high level of commitment in becoming resilient cities. Furthermore, all the cities taking part in this research are working together on the improvement of European cities’ resilience by participating in the European Smart Mature Resilience Project and are at different stages of maturity in the resilience-building process (Smart Mature Resilience, 2016).

The participants in the interviews were representatives from the City Councils of these cities who were knowledgeable about the policies implemented in the cities with regards to disaster risk and management, climate change adaptation, and resilience development. Table 3.3 resumes the profile of the city representatives that participated in the interviews. The reason for

interviewing representatives from the City Councils was to identify the steps carried out by the local governments of the different cities to improve the collaboration with city stakeholders in the resilience-building process.

The first section of the interview proposed a list of different city stakeholders that, based on the information gathered from the literature, need to be involved in the city resilience building process. In the second section of the interview, participants were asked to explain the main policies that the City Councils had implemented in their cities to foster *collaboration*, *awareness*, *preparedness*, and *learning* principles. The data obtained from the interviews was triangulated with documentation (official website, reports, and plans) of each city (Tickle et al., 2011). The questionnaires that were prepared for the semi-structured interviews are available in Appendix C.

Table 3.3: Participants in the semi-structured interviews.

PROFILE OF THE PARTICIPANTS	ORGANIZATION	YEARS OF EXPERIENCE
Deputy Civil Protection Manager	Bristol City Council	10
Assistant Manager of Sustainability Department	Glasgow City Council	13
Project Manager	Kristiansand City Council	9
Security and Crisis Manager	Kristiansand City Council	12
Firefighter Officer	Donostia-San Sebastián City Council	8
Technical Assistant for Strategic Planning	Donostia-San Sebastián City Council	11
Natural Hazard Assessment Expert	Rome City Council	20
Director of Urban Quality and Energy and Environmental Certification Unit	Rome City Council	40
Head of the Fire Brigade	Vejle City Council	20
Manager of Resource Centre	Vejle City Council	15

The second phase of the research consisted of identifying the steps taken by local governments of different cities to collaborate with stakeholders in the resilience-building process. In this phase, governmental official websites, reports, and strategic plans for building resilience from different City Councils, local and regional governments were reviewed (Table 3.4). In addition to these reports, the information gathered in the previous semi-structured interviews

was analyzed. Based on this information, a description of the maturity stages for improving the collaboration with city stakeholders and the policies that need to be implemented by the local government at each stage were defined.

Table 3.4: Resilience strategies reviewed.

YEAR	TITLE OF THE REPORT	TOPIC	SOURCE
2012	Preparing Scotland: Scottish Guidance on Resilience	Guidance on Resilience	The Scottish Government
2013	Preparing for Disasters in Global Cities: An International Comparison	Disaster Management	Center for Security Studies (ETH, Zurich)
2013	London Resilience Partnership	City Resilience Strategy	London Resilience Forum
2013	Barcelona Building Resilience Strategies	City Resilience Strategy	Barcelona City Council
2015	Our Resilient Glasgow A City Conversation	Resilience Challenges	Glasgow City Council
2015	Vejle Resilience Strategy	City Resilience Strategy	Vejle Kommune and the Rockefeller Foundation
2015	Rotterdam Resilience Strategy	City Resilience Strategy	Gemeente Rotterdam, Climate Initiative and the Rockefeller Foundation
2015	New Orleans Resilience Strategy	City Resilience Strategy	City of New Orleans and the Rockefeller Foundation
2016	Melbourne Resilience Strategy	City Resilience Strategy	Resilient Melbourne and the Rockefeller Foundation
2016	Glasgow Resilience Strategy	City Resilience Strategy	Glasgow City Council, Resilient Glasgow and the Rockefeller Foundation
2016	Bristol Resilience Strategy	City Resilience Strategy	Bristol City Council and the Rockefeller Foundation

Afterwards, a second round of interviews was conducted in order to identify the effective path and the sequence of stages that the local governments need to follow for improving the collaboration with city stakeholders in the resilience-building process. These interviews were carried out with the ten city representatives that participated in the previous interviews. In these interviews, city representatives were provided with a description of the identified maturity

stages and were asked to put them in order, from the less to the more advanced stage. The different maturity stages were ordered alphabetically so as to avoid influencing respondents with a suggested order. Furthermore, participants were allowed to add additional maturity stages in case they considered any to be missing; they could also indicate if they considered some of them to be equal or delete those that they thought redundant. This feedback was used to redefine the maturity stages and to develop the stakeholder-collaboration maturity model. The questionnaires and the results can be found in Appendix D.

3.3.3 Survey for validating indicators

After the development of the stakeholder-collaboration maturity model, a set of indicators for assessing the policies included in the stakeholder-collaboration maturity model were defined. These indicators were identified from the literature review on city resilience. In order to validate the defined indicators, a confirmatory survey was carried out with representatives from different cities.

A survey consists of a systematic and standardized approach to collect information from a group of people through questionnaires (Forza, 2002). Surveys can contribute during the early stages of the research gaining preliminary insight on a topic (exploratory survey research). Surveys can also help in the later stages of research testing the adequacy of the concepts or constructing a theory (confirmatory survey research) (Kerlinger, 1999). Confirmatory survey research takes place when knowledge of a phenomenon is articulated in a theoretical form using well-defined concepts, models and propositions (Malhotra and Grover, 1998).

In this research, the survey method was used as confirmatory research to validate the proposed indicators for evaluating the polices defined in the stakeholder-collaboration maturity model. In order to conduct the survey, a mail-questionnaire was used due to following reasons. Mail-questionnaire are easy to distribute across participants. Furthermore, experts can easily access to it just clicking on the URL provided (Solomon, 2001).

In total 11 representatives from different European cities completed the survey. Information about the participants of the survey can be found in Table 3.5. Participants in the survey were provided with a list of indicators, the description of the indicators, and examples of the indicators for assessing the collaboration between city stakeholders in awareness, preparedness, and learning processes within the city. A four level Likert-type scale (4-Strongly agree; 3-Agree, 2-Disagree; 1-Strongly Disagree; 0-Don't know) was provided to determine to what extent they agree or disagree with the usefulness of the proposed indicators. Furthermore, participants were asked to provide information the indicators that are used in their cities. The survey can be found in Appendix E.

Table 3.5: Participants in the survey.

PROFILE OF THE PARTICIPANTS (N° OF PARTICIPANTS)	ORGANIZATION
Emergency manager (1)	Bristol City Council
Resilience Officer (1) Sustainability Assistant Manager (1)	Glasgow City Council
Councilor Social Welfare Department (1) Director of the Environmental Health and Sustainability Service (1) Firefighter Officer (1) Technical Assistance from the Strategic Planning Department (1)	Donostia/San Sebastián City Council
Technician from the Emergency Service (1)	Basque Government
Project manager (1)	Kristiansand City Council
Manager of Resource Centre (1)	Vejle City Council
Director of Urban Quality and Energy and Environmental Certification Unit (1)	Rome City Council

3.4 Implementation phase: Case study

Once the stakeholder-collaboration maturity model was developed, the case study was chosen as a research method to implement the stakeholder-collaboration maturity model. A case study is defined as “*an empirical inquiry that investigates a contemporary phenomenon within its real-life context, when the boundaries between phenomenon and context are not clearly evident, and in which multiple sources of evidence are used*” (Yin, 1994, p. 23). A case study attempts to illuminate a decision or set of decisions: why they were taken, how they were implemented, and with what result (Yin, 2009). The case study method allows the identification of the current developmental approaches in the real-life context (Benbasat et al., 1987).

Case study method provides a set of advantages to the research:

- Several sources of data can be gathered obtaining evidences from both quantitative and qualitative categories in order to ensure the reliability of the acquired data.
- Complexities of real-life situations can be captured through detailed accounts and real-life experiences that the researcher can obtain during the stay in the real place.

The case study method is a versatile research methodology, that can be used both with the exploratory purposes but also to construct, extend or test theory (Rowley, 2002). In our research, iterative methodologies were applied to develop the stakeholder-collaboration maturity model and then, the case study method was used to implement the developed maturity model. The case study method aimed at gathering information about the examples and evidence of the sequential order of policies for the involvement of stakeholders in the resilience-building process. Furthermore, the gathered examples and evidence for each policy provided insight about how the stakeholder-collaboration maturity model can be applied at cities that are at different maturity stages.

To reach the objectives of the case study, the most appropriate cities for implementing the stakeholder-collaboration maturity model are cities whose local governments are committed to collaborating with city stakeholders in the

resilience-building process. Furthermore, cities that are at different maturity stages can provide the necessary information to validate the sequence of policies defined in the stakeholder-collaboration maturity model.

In this research, a case study was carried out in the city of Glasgow (United Kingdom) and another case study was carried out in the city of Donostia/ San Sebastián (Spain). On the one hand, the city of Glasgow is recognized worldwide for its high commitment in building resilience and its involvement in networks of resilient cities such as the 100 Resilient Cities programme and Smart Mature Resilience project. Furthermore, it has been the first city in the United Kingdom to develop and launch a city resilience strategy. On the other hand, the city of Donostia/ San Sebastián has recently begun to work on the concept of city resilience since its involvement in 2015 in the Smart Mature Resilience project.

The case study method is often accused of lack of rigor because the researcher can equivocate in obtaining data or even influence the direction of the findings to his interests (Zainal, 2007). A way to overcome this problem is by triangulating the study with other methods (Tickle et al., 2011). Multiple sources of information such as interviews, internal documents, and observations ensures the reliability and correctness of the data to provide more confidence to the obtained results (Tickle et al., 2011).

During the case studies carried out within this research, the information gathered from the cities under study was triangulated with different sources: interviews, official documentation of the city (such as disaster and resilience plans and reports), and web pages. In both cities a total of 14 interviews were conducted with stakeholders involved in the resilience-building process such as the emergency services, different departments of the City Council, state-run entities (universities and public health services) and private companies. The objective of the interviews was to gather examples and evidence of how the policies defined in the stakeholder-collaboration maturity model had been implemented in the cities under study. Interviewees were principally selected using the snowballing interview technique. This enables a particular research network to develop the sample of interviewees rather than the researcher randomly interviewing respondents (Kythreotis & Bristow, 2016). Further

information of the participants in the two case studies can be found in Table 3.6 and Table 3.7.

Finally, to evaluate usefulness of the proposed stakeholder-collaboration maturity model, two final interviews were arranged with representatives from the cities in charge of the coordination and development of the city resilience building process. During these interviews, we explained the stakeholder-collaboration maturity model and asked them for feedback on the sequence of the maturity stages, on the stakeholders and policies involved. We also presented the interviewees with evidence and examples, based on the information gathered from the previous interviews, of how the different policies defined in the stakeholder-collaboration maturity model had been implemented in their cities. The feedback from this interview helped to verify the usefulness of the policies defined in the different stages of the stakeholder-collaboration maturity model.

Table 3.6: Participants in the case study carried out in Glasgow.

PROFILES OF THE PARTICIPANTS (N° OF PARTICIPANTS)	ORGANIZATION
Assistant Manager (1) Manager (1) Officer (1)	Sustainability Department from Glasgow City Council
Chief Resilience Officer (1)	Resilient Team from Glasgow City Council
Public Health Programme Manager (1)	Glasgow Centre for Population Health
Civil Contingencies Officer (1)	Scottish Fire and Rescue Services
Civil Contingencies Officer (1) Technician from the Resilience Unit (3)	Emergency Services Coordination from Glasgow City Council
Development Officer on Community Resilience (1)	Education Department from the Scottish Government
Programme Manager (1)	Adaptation Scotland
Director of Sustainable Cities and Energy Policy (1)	Strathclyde University
Senior Engineer in Infrastructure (1)	ARUP Consultancy

Table 3.7: Participants in the case study carried out in Donostia/San Sebastián.

PROFILE OF THE PARTICIPANTS (N° OF PARTICIPANTS)	ORGANIZATION
Councilor (1)	Social Welfare Department from the City Council
Firefighter Officer (1) Technician of Civil Protection (1)	Civil Protection Department from the City Council
Coordinator of working group (1)	Technical Committee from the City Council
Technical Assistant (1)	Strategic Planning Department from the City Council
Director (1)	Environmental Health and Sustainability Service from the City Council
Director (1) Technician (1)	Citizen Participation Service from the City Council
Economic Sustainability Engineer (1) Technician (1)	Fomento - Development Agency from the City Council
Director (1)	Emergency Service, Meteorology and Security Department from the Basque Government
Director (1) Technician (1)	Emergency Service from the Basque Government
Project Management Technician (1)	IHOBE -Public Society of Environmental Management from the Basque Government

3.5 Conclusions

The research methodology applied in this research is composed of three main phases: conceptualization, development and implementation of the stakeholder-collaboration maturity model. The conceptualization phase included a literature review to determine the research gap and questions and to analyze existing frameworks for building city resilience. During the development phase, a Delphi study and semi-structured interviews were conducted to gather knowledge from multidisciplinary experts in the field of resilience. Furthermore, indicators for evaluating the implementation of the policies included in the stakeholder-collaboration maturity model were validated through a survey.

Once the stakeholder-collaboration maturity model was developed, it was implemented through two case studies at two cities at different stages of maturity. During the case studies, evidence and examples for the policies as well as information on the temporal order of their implementation were obtained.

4 Resilience Principles

This section analyzes the contribution of the collaboration between the city stakeholders to the resilience-building process. It presents different participatory processes to improve the collaboration between the city stakeholders in the resilience-building process.

Furthermore, it presents the results of a literature review that was carried out to identify the resilience aspects and characteristics that improve through the collaboration of stakeholders in the resilience-building process. As a result of a literature review, collaboration, awareness, preparedness, and learning principles were defined. Based on the hypothesis that collaboration principle contributes to the improvement of awareness, preparedness, and learning principles, this chapter presents the results of a Delphi that was carried out with a group of experts in the disaster resilience field.

4.1 Participatory processes for building city resilience

Collaboration is a key element that contributes to the success of the resilience-building process (Sawalha, 2014). Collaboration facilitates the response to immediate needs of stakeholders and supports an effective management of disasters (Cavallo & Ireland, 2014, Kapucu & Hu, 2014, Sawalha, 2014). In this vein, failing to collaborate in disaster situations increases the vulnerability of cities towards potential disasters (Waugh & Streib, 2006).

The capacity of stakeholders to collaborate with each other, however, does not occur spontaneously and has to be planned and prepared in order to function properly (Sawalha, 2014). Resilience management research recognizes that it is necessary to carry out participatory processes for stakeholders to develop common understanding and share knowledge (Olazabal & Pascual, 2016). Participatory processes can vary from public consultation and meetings where stakeholders receive information, to two-way exchange of information between stakeholders (such as communities of practice, steering committees or partnerships) (Reed, 2008, Sarzynski, 2015). Following, different participatory processes to improve the collaborating between city stakeholders in the resilience-building process are presented.

4.1.1 Public meetings for open dialogue on resilience

Collaboration can take place by the involvement of stakeholders at public meetings held by the local government in order to set priorities and objectives. The involvement of city stakeholders in the definition of strategic objectives helps to ensure that they are well tailored to the actual vulnerabilities and to the needs of the stakeholders likely to be affected (de Carvalho et al., 2016). Furthermore, the involvement of different stakeholders in meetings is of utmost importance for creating spaces for discussions, where a consensus view on what to do should enable the development of appropriate actions (de Carvalho et al., 2016).

4.1.2 Public-private partnerships

A more collaborative and sustained governance response involves the formation of public-private partnerships (PPPs) to coordinate and implement specific actions. PPPs bring resources (financial, managerial, organizational, political) and expand institutional capacity for governance. Additionally, the presence of public and private entities suggests the potential for more sustained and meaningful participation in governance (Stewart et al., 2009).

4.1.3 Communities of Practice (CoPs)

Aimed at grouping people with similar interests, a Community of Practice (CoP) is a group of individuals or organizations who, on a voluntary basis, exchange information and undertake joint activities (Kapucu, 2005). CoPs have been described as “*groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis*” (Wenger et al., 2002, p. 4). The intent of CoPs is to share knowledge, develop best practices, drive a common understanding, and build awareness within the community of experts (Ward et al., 2014).

Resilience-building actions require shared decision-making, open dialogue, building mutual understanding and resolving differences and conflicts between multiple stakeholders (Oxley, 2013). In the field of disaster management, CoPs provide an appropriate structural model for stakeholders from different organizations and countries to work collaboratively (Turoff et al., 2011). For this reason, CoPs that enhance inter-organizational collaboration networks based on interaction of diverse organizations have emerged to address the complex and interconnected issues to build up the resilience level of organizations (Djalante et al., 2013, Jung & Song, 2014).

4.1.4 Multi-stakeholder steering committees

Another option for sustaining stakeholder participation in government-led processes involves the creation of multi-stakeholder steering committees where representatives from different stakeholders provide feedback and oversee

ongoing actions after plans are developed (Sarzynski, 2015). Moreover, the actions should be monitored by the participants of the steering committee to verify their effectiveness and to check that the defined objectives are achieved (de Carvalho et al., 2016).

Collaboration between different stakeholders in steering committees enhances the quality of the decisions related to the resilience-building process by considering more comprehensive information inputs (Reed, 2008). By involving stakeholders in decision-making, it is argued that the quality and durability of decisions is likely to be greater (Sarzynski, 2015). Furthermore, by establishing common ground and trust between stakeholders, participatory processes have the capacity to appreciate others' viewpoints and find new ways for participants to work together (Reed, 2008).

4.2 Resilience principles

A literature review was carried out in order to identify the principles that can be improved through the collaboration of stakeholders in the city resilience-building process. Following, a set of research studies that present the characteristics and aspects of resilience are described.

Lu and Stead (2013) examines how planning processes in the city of Rotterdam deal with potential risks. The authors identify six characteristics of organizational resilience. First, they recognize the need to learn from previous experiences, both positive and negative (ability to learn) and the ability to involve the public and foster their participation in policy decisions. Furthermore, they recognize the need to be aware and understand the existing conditions of the city (attention to current situation) and commit resources and initiate action to respond to issues such as climate change (ability to set goals and initiate actions). Finally, they emphasize the need to prepare for future disturbances on the basis of current information (attention to trends and future threats).

In line with this, Oxley (2013) recognizes that strengthening resilience is a dynamic process that is embedded within the day to day activities. The author considers that the resilience-building process involves eight organizational

principles (*preparedness, responsiveness, inclusion, connectivity, learning, self-organization, diversity and social cohesion*) that enhance adaptive capabilities to respond and adjust to an increasing and unpredictable array of disasters.

Furthermore, Evers et al. (2015) recognize social learning as a key factor for awareness raising, better preparedness, and capacity building for increased flood resilience. They emphasize the importance of participatory governance and collaborative decision-making for flood risk management. According to these authors, learning elevates the overall risk awareness within communities and opens up possibilities for participatory decision making that may lead to commonly agreed alternatives and strategies for building city resilience.

In this vein, Khalili et al. (2015) provide a framework that includes a set of factors that contribute to enhancing resilience within communities in the prevention and mitigation, response and recovery phases of a disaster. The defined factors can be found in Table 4.1. According to these authors, the defined factors need to be developed across different stakeholders such as individuals, communities, volunteers, emergency organizations as well as at different scales (international, national, regional, and local).

Finally, Tyler and Moench (2012) propose a conceptual framework for urban climate resilience in which they propose three organizational resilience principles (*responsiveness, resourcefulness, and capacity to learn*). Responsiveness refers to the capacity of stakeholders to be aware of hazards, anticipate and prepare for a disruptive event. Resourcefulness refers to the capacity of stakeholders to mobilize various assets and resources through collaboration. Capacity to learn encompasses the ability of stakeholders to internalize past experiences, avoid repeated failures and learn new skills.

Based on the similarities of the resilience aspects identified from the analyzed articles, this research has classified them into *collaboration, awareness, preparedness, and learning* resilience principles. Table 4.1 presents the resilience aspects presented in the analyzed articles classified into the proposed resilience principles. Afterwards, the definitions of the resilience principles are provided.

Table 4.1: Classification of the resilience aspects presented in the analyzed articles into the resilience principles.

AUTHOR (YEAR)	COLLABORATION	AWARENESS	PREPAREDNESS	LEARNING
Tyler et al. (2010)	Resourcefulness	Responsiveness		Capacity to learn
Lu and Stead (2013)	Involve public responses	Attention to current situation	Attention to trends and future threats	Learn from previous experience
Oxley (2013)	Connectivity and inclusion	Awareness and diversity	Preparedness, responsiveness and self-organization	Learning
Evers et al. (2015)	Participatory and collaborative decision-making	Awareness raising	Preparedness and capacity development	Social learning
Khalili et al. (2015)	Exchange of information community participation and coordination	Education	Coping style (adapting capacity and developing strategy)	Learning

4.2.1 Collaboration

Collaboration is a set of activities directed towards the achievement of common goals often working across boundaries and in multi-stakeholder relationships (Kapucu et al., 2010, Oxley, 2013). Increasing a city's resilience to disasters requires the collaboration and coordination of all stakeholders (Malalgoda et al., 2013). It is through strategic alliances predicated on collaboration that inter-agency dialogue can take place, resources can be pooled and duplication of efforts can be avoided (Evers et al., 2015). In this vein, governments need to collaborate with the different stakeholders to collect feedback on citizens assets and needs (Cavallo & Ireland, 2014).

4.2.2 Awareness

Raising awareness refers to improving the level of understanding of the city stakeholders on the needs and challenges to build city resilience (Lu & Stead,

2013). Previously developed collaboration agreements between city stakeholders for building resilience, increases the awareness of stakeholders on potential risks and vulnerabilities (Oxley, 2013).

In this vein, it is necessary to educate citizens on the spectrum of threats they face and disseminate knowledge from previous events to stakeholders who want to take action in the resilience-building process (Tyler & Moench, 2012). Furthermore, reward and recognition can also act as way of motivating individuals and organizations to participate in resilience-building activities.

4.2.3 Preparedness

Building resilience is based on a culture of preparedness, in which individuals, communities and organizations improve their level of preparedness and anticipatory viewpoint focus (O'Brien & Read, 2005, Oxley, 2013).

The continual development of individual skills through regular training exercises increases the coordination of stakeholders in case of disasters and keeps them engaged in the absence of disasters (Sawalha, 2014). Thus, building resilience should be seen a dynamic process that is embedded within the day to day activities of city stakeholders (Oxley, 2013). In this context, the government should consider where there is scope for city stakeholders to be involved in joint training and exercising (Evers et al., 2015, Lu & Stead, 2013).

4.2.4 Learning

Sharing lessons from others who have experienced similar situations is probably one of the most important steps that stakeholders involved in disaster management can take in order to improve the preparation, response and recovery of future disasters (Lu & Stead, 2013, Tyler & Moench, 2012). The process of learning from past experiences to gain knowledge about how to face future challenges becomes crucial and helps to build a shared vision about the future (Olazabal, 2017).

Furthermore, multi-stakeholder learning processes open up possibilities for developing more creative solutions through reflective deliberation (Evers et al.,

2015). In this vein, learning contributes to the overall awareness of the resilience-building process and participatory decision making that may lead to commonly agreed strategies for building city resilience (Khalili et al., 2015, Evers et al., 2015).

4.3 Contribution of collaboration to improving resilience principles

It is increasingly recognized in the resilience disaster literature that building city resilience is an inclusive and participatory process that relies on the collaboration of many different stakeholders (Weichselgartner & Kelman, 2014). Therefore, the hypothesis of this research is that *collaboration* principle improves *awareness*, *preparedness*, and *learning* principles (see Figure 4.1). To do so, a Delphi study was carried out with a group of multi-disciplinary and international experts in the disaster resilience field.

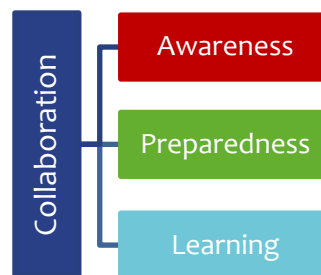


Figure 4.1: Resilience principles.

The results obtained in the first round of the Delphi process confirmed the positive contribution of the *collaboration* principle to the improvement of *awareness*, *preparedness*, and *learning* principles (Table 4.2). Most of the experts agreed or strongly agreed that *awareness*, *preparedness*, and *learning* principles improve through *collaboration* principle.

Table 4.2: Results of the first round of the Delphi study.

RESILIENCE PRINCIPLES	Strongly agree	Agree	Disagree	Strongly disagree	Don't know
Awareness principle statements:					
1. Collaboration increases top managers' awareness.	18	24	2	0	1
2. Collaboration encourages top managers to assigning resources for the resolution of problems.	17	23	4	0	1
3. Collaboration promotes proactive postures among staff to share information.	17	27	1	0	0
4. Collaboration improves trust and teamwork among staff.	13	26	4	2	0
5. Collaboration encourages staff to be actively concerned with developing skills to improve resilience	19	23	1	0	2
6. Collaboration helps organizations be more aware of its vulnerabilities against potential crisis.	19	22	1	0	3
7. Collaboration improves the existing disaster procedures in the organization.	17	22	1	0	5
8. Collaboration helps to understand better the complex interdependencies across organizations.	18	23	1	1	2
Preparedness principle statements:					
9. Collaboration helps to share training materials across organizations.	24	19	0	0	2
10. Collaboration helps to share and repeat courses that have a good reputation in different organizations.	25	18	1	0	1
11. Collaboration facilitates the availability of disaster management procedures, regulations, and legislations.	20	22	1	1	1
12. Collaboration helps to contact new partners.	20	24	0	0	1
13. Collaboration enables to find the experts and organizations with more expertise and experiences to handle a problem.	18	18	5	0	4
14. Collaboration helps organizations to have unified procedures and disaster plans.	15	17	5	0	8
15. Collaboration makes different organizations that might collaborate have a unified purpose in the management future events.	16	22	3	0	4
16. Collaboration improvise coordination among organizations.	12	24	3	2	4
17. Collaboration helps to get assistance from other organizations.	13	24	4	2	2

Learning principle statements:					
18. Collaboration improves staff members' learning.	27	17	0	0	1
19. Collaboration helps the staff to learn from other's best practices and lessons learned.	17	21	4	0	3
20. Collaboration helps to learn from events occurred and lessons learned identified in other organizations.	20	25	0	0	0
21. Collaboration increases creativeness among the staff of the organization.	17	26	1	0	1
22. Collaboration facilitates obtaining experts' assistance when something unexpected comes up.	18	17	5	0	5

In order to quantify to what extent *collaboration* principle contributes to improving *awareness*, *preparedness*, and *learning* principles, a second round of the Delphi study was carried out. This time, experts were asked to quantify the influence of each statement using a ten-point Likert-type scale (ranging from no influence/very low influence to strong influence). The results of the second round of the Delphi process revealed that *collaboration* principle is perceived as having a positive influence on the improvement of *awareness* (overall mean equal to 7.57), *preparedness* (overall mean equal to 7.67), and *learning* (overall mean equal to 8.05), principles since the obtained overall means of the three principles are higher than 7.57 (see Table 4.3).

According to the Delphi results, *collaboration* principle contributes to increasing stakeholders' awareness level (statement 1) and encourages them to allocate resources to promote a resilience-based culture (statement 2). Furthermore, the majority of the Delphi participants recognized that *collaboration* promotes proactive postures to share information (statement 3), improves trust and teamwork (statement 4), and encourages stakeholders to develop their skills to improve resilience (statement 5). Also, it was found that *collaboration* increases stakeholders' level of awareness towards potential risks (statement 6), existing disaster procedures (statement 7), and complex interdependencies across organizations (statement 8).

Moreover, based on the Delphi results, *collaboration* principle contributes to the *preparedness* principle. On the one hand, it enhances sharing training materials

(statement 9), courses (statement 10), and existing disaster management procedures and regulations between stakeholders (statement 11). Furthermore, *collaboration* principle helps to contact new partners, experts, and organizations in the field of disaster management (statements 12 and 13). According to participants in the Delphi study, *collaboration* principles allows organizations to exchange procedures and disaster plans and collaborate to unify them (statements 14 and 15). Also, it increases the coordination of stakeholders and organizations (statement 16) and the opportunity to provide and receive assistance in case of a disaster (statement 17).

Finally, according to the Delphi results, *collaboration* principle contributes to increasing learning across stakeholders and organizations. First, it helps stakeholders to learn from each other (statement 18) and share lessons learned (statement 19). It also allows stakeholders and organizations to exchange lessons learned and therefore learn from their own as well as others' experiences (statement 20). Furthermore, the results reveal that *collaboration* increases creativeness across the stakeholders (statement 21) and provides access to experts' assistance (statement 22).

In summary, it has been possible to confirm the positive influence of *collaboration* principle to improving *awareness*, *preparedness*, and *learning* principles. Overall, the results of the Delphi study show that the majority of participants confirm that *collaboration* principle improves the set of statements defined for *awareness*, *preparedness*, and *learning* principles. It should be highlighted that the defined statements have a minimum score equal to 7.14 and a maximum score equal to 8.50.

Table 4.3: Results of the second round of the Delphi study (Influence of each statement quantified on a ten-point Likert-type scale).

RESILIENCE PRINCIPLES		Overall mean (out of 10)
Awareness principle statements:		7.57
1.	Collaboration increases top managers' awareness.	7.14
2.	Collaboration encourages top managers to assigning resources for the resolution of problems.	7.41
3.	Collaboration promotes proactive postures among staff to share information.	7.93
4.	Collaboration improves trust and teamwork among staff.	7.53
5.	Collaboration encourages staff to be actively concerned with developing skills to improve resilience	7.60
6.	Collaboration helps organizations be more aware of its vulnerabilities against potential crisis.	7.63
7.	Collaboration improves the existing disaster procedures in the organization.	7.79
8.	Collaboration helps to understand better the complex interdependencies across organizations.	7.63
Preparedness principle statements:		7.67
9.	Collaboration helps to share training materials across organizations.	7.93
10.	Collaboration helps to share and repeat courses that have a good reputation in different organizations.	8.00
11.	Collaboration facilitates the availability of disaster management procedures, regulations, and legislations.	7.47
12.	Collaboration helps to contact new partners.	8.40
13.	Collaboration enables to find the experts and organizations with more expertise and experiences to handle a problem.	7.62
14.	Collaboration helps organizations to have unified procedures and disaster plans.	7.21
15.	Collaboration makes different organizations that might collaborate have a unified purpose in the management future events.	7.28
16.	Collaboration improves coordination among organizations.	7.34
17.	Collaboration helps to get assistance from other organizations.	7.77
Learning principle statements:		8.05
18.	Collaboration improves staff members' learning.	8.47
19.	Collaboration helps the staff to learn from other's best practices and lessons learned.	8.50
20.	Collaboration helps to learn from events occurred and lessons learned identified in other organizations.	8.21
21.	Collaboration increases creativeness among the staff of the organization.	7.52
22.	Collaboration facilitates obtaining experts' assistance when something unexpected comes up.	7.57

4.4 Conclusions

Collaboration between the local government and city stakeholders is necessary to improve the city resilience-building process. This research describes different participatory processes to build collaboration between city stakeholders. These participatory processes will be taken into account to develop the stakeholder-collaboration maturity model.

Furthermore, a literature review was carried out within this research to identify the resilience aspects and characteristics that improve through the collaboration of stakeholders in the resilience-building process. As result of the literature review, *collaboration*, *awareness*, *preparedness*, and *learning* principles were defined.

With regards to these principles, this research analyzes the potential contribution of *collaboration* principle to improving *awareness*, *preparedness*, and *learning* principles. To do this, a Delphi study was carried out with a group of experts in the field of disaster management. The results of the Delphi confirm the contribution of *collaboration* principle to the improvement of *awareness*, *preparedness*, and *learning* principles. These resilience principles will be taken into account in the development of the stakeholder-collaboration maturity model presented in this research.

Stakeholder-Collaboration Maturity Model

This section presents the stakeholder-collaboration maturity model developed in this research. The stakeholder-collaboration maturity model provides local governments with a reference framework to improve progressively the collaboration with city stakeholders in the resilience-building process. The stakeholder-collaboration maturity model describes a sequence of five maturity stages and each stage indicates the stakeholders that need to be involved and the policies that need to be implemented to progress to a more advanced maturity stage. Moreover, the developed stakeholder-collaboration maturity model provides indicators to help local governments to evaluate the level of implementation of the policies included in the maturity stages. Finally, the methodology to implement the stakeholder-collaboration maturity model is explained.

5.1 Stakeholder-collaboration maturity model

This research provides local governments with a stakeholder-collaboration maturity model to improve progressively the collaboration with the city stakeholders in the resilience-building process. The stakeholder-collaboration maturity model was developed based on the evolution of collaboration of stakeholders in different cities working towards the improvement of their resilience level. The stakeholder-collaboration maturity model is composed of the following elements:

- A sequence of maturity stages for improving the collaboration between the local government and city stakeholders. Each maturity stage outlines the policies that the local government needs to implement and the stakeholders that need to be involved in the implementation of the policies.
- The evolution of the roles of the different city stakeholders throughout the maturity stages.
- Indicators for assessing the implementation of the policies included in the stakeholder-collaboration maturity model.
- Implementation methodology of the stakeholder-collaboration maturity model.

5.2 Maturity stages

The stakeholder-collaboration maturity model describes the progress from the *unrecognized* stage through the *initial*, *formalized*, and *supportive* stages to the most advanced stage, *proactive* stage. Furthermore, the evolution of the *awareness*, *preparedness*, and *learning* principles through the *collaboration* principle is described in each maturity stage. Each maturity stage represents a generic characterization that can be applied to any city. Although not every city will be initially at the first stage, the maturity stages are meant to be taken successively without skipping over any stage. Table 5.6 provides information on the policies that the

local government needs to implement in each maturity stage. Furthermore, it provides information on the stakeholders that are actively involved in the implementation of the policies of each maturity stage.

5.2.1 Unrecognized stage

In the *unrecognized* stage, the local government and the emergency services identify, plan, and prepare for disaster (i.e. take measures to reduce disaster impacts and develop disaster plans). Furthermore, representatives from the local government and emergency services provide information on protection measures prior to the occurrence of a disaster. Also, the local government arranges training exercises and drills with the emergency services.

At this stage, after the occurrence of a disaster, the local government and emergency services involved in disasters carry out an evaluation of existing plans and procedures. However, no further stakeholders are involved in training exercises and the evaluation of disaster plans and procedures. Local government and emergency services lack to collaborate with citizens, companies, CIs, volunteer organizations, media, and educational and scientific entities in the city resilience-building process. Table 5.1 describes the policies included in the *unrecognized* stage.

Table 5.1: Policies in the *unrecognized* stage.

UNRECOGNIZED STAGE	
AWARENESS	<p>Policy 1.1: Communicate and disseminate potential risks and protection measures.</p> <p>The local government needs to establish official communication channels (social media, to alert stakeholders of potential disasters such as storms, floods, droughts, or landslides. Communication through these channels enables citizens, communities and organizations threatened by hazards to prepare and to act properly. Furthermore, the local government needs to provide the media with official information and press releases on disaster, protection measures and recommendations to disseminate this information through internet, social media, television, radio and newspapers channels.</p>

PREPAREDNESS	<p>Policy 1.2: Develop agreements with the emergency services to identify, plan, and manage disasters.</p> <p>The local government needs to establish collaboration agreements with emergency services to identify potential disasters, develop disaster plans, and establish response procedures in case of disasters. Furthermore, disaster plans that define the roles and responsibilities from the entities of the emergency services need to be developed.</p> <p>Policy 1.3: Test disaster plans and arrange training exercises.</p> <p>The local government needs to test disaster plans by arranging regular training and drills with the different entities of the emergency services and the local government. Training exercises and drills enhance the preparation, response and coordination of the entities from the emergency services and the local government.</p>
LEARNING	<p>Policy 1.4: Carry out post-disaster evaluation to improve disaster plans.</p> <p>The local government and emergency services carry out together an evaluation of past disasters they have been involved in. The evaluations aim at analyzing and verifying if existing disaster procedures and actions are appropriate or need to be improved.</p>

5.2.2 Initial stage

The local government recognizes the need to develop a holistic resilience strategy that integrates efforts made by the city stakeholders to improve the city resilience level. In this vein, the local government starts to seek collaboration opportunities and resources for improving the city resilience level. The local government and emergency services give information to stakeholders in risk-prone areas about preventive measures, disaster plans and procedures in order to improve their capacity to respond to disasters. Furthermore, the local government establishes agreements with volunteer organizations and CIs.

While at this stage the local government recognizes the need of developing a city resilience strategy, the strategy needs to be developed and the actions that the different city stakeholders need to implement need to be defined. Table 5.2 describes the policies included in the *initial* stage.

Table 5.2: Policies in the *initial* stage.

INITIAL STAGE	
AWARENESS	<p>Policy 2.1: Organize informative sessions to provide basic preventive measures to citizens and companies in risk-prone areas.</p> <p>The local government needs to organize regular public informative meetings with citizens and companies in risk prone areas to explain them disaster plans and provide them with basic preventive measures (identify safe places, evacuation procedures, insurance coverage, instructions on how to protect their properties...) in order to improve their capacity to respond in case of a disaster.</p>
PREPAREDNESS	<p>Policy 2.2: Initiate agreements with the CIs to develop and share disaster plans.</p> <p>The local government needs to initiate agreements such as Public-Private partnerships for sharing relevant information (contingency plans, contact details, resources) with the CIs. This information is helpful for local government to know the procedures that the CIs have in place to continue to deliver key services and be able to operate and recover quickly when they are affected by disasters.</p> <p>Policy 2.3: Initiate partnerships with volunteer organizations to involve them in the preparation and response of disasters.</p> <p>The local government needs to establish collaboration agreements such as Public-Private partnerships with volunteer organization to collaborate with them in disaster management activities and involve them in training and preparation exercises. Through collaboration agreements the role and the responsibilities of the volunteer organizations are set up and resources to accomplish their functions are provided.</p>
LEARNING	<p>Policy 2.4: Establish procedures and mechanisms to share lessons learned.</p> <p>The local government needs to establish procedures and mechanisms (such as platforms, tools or protocols) to enhance the identification, documentation, and exchange of lessons learned after the occurrence of disasters with the emergency services, CIs, and volunteer organizations.</p>

5.2.3 Formalized stage

In the *formalized* stage, the local government develops a city resilience strategy that includes the actions that need to be implemented to build the city resilience level. The strategy defines the roles of the different stakeholders in the implementation of the resilience actions. Furthermore, the local government establishes regular debriefing meetings with the emergency services, CIs, volunteer organizations and academic, educational and scientific entities to

analyze, identify and share lessons learned and best practices from different points of view on disasters management.

Despite the fact that the local government develops a city resilience strategy, the resilience strategy needs to be implemented. Moreover, at this stage collaboration with citizens and companies needs to be promoted. Table 5.3 describes the policies included in the *formalized* stage.

Table 5.3: Policies in the *formalized* stage.

FORMALIZED STAGE	
AWARENESS	<p>Policy 3.1: Formalize partnerships with academic, educational and scientific entities to organize resilience awareness programs.</p> <p>The local government needs to develop partnerships such as Public-Private partnerships with academic, educational, and scientific entities to organize awareness activities (i.e. education programs in schools, public meetings, and conferences) to promote the resilience-building process. The objective of these activities is to raise stakeholders' awareness and involve them in the resilience-building process.</p> <p>Policy 3.2: Establish working groups to develop a city resilience strategy.</p> <p>The local government needs to arrange working groups (such as Communities of Practice) with experts in different topics related to the city resilience-building process such as climate change adaptation or business continuity planning. The experts include representatives from the different departments of the local government, the emergency services, CIs, volunteer organizations, and academic and scientific entities. The establishment of working groups aims at broadening relationships between city stakeholders, work together to identify resilience actions, and agree on the objectives of the resilience strategy.</p>
	<p>Policy 3.3: Define the roles of the stakeholders to implement resilience actions.</p> <p>The local government needs to develop a city resilience strategy that describes the actions and the objectives that need to be implemented in the short, medium and long term to improve the city resilience level. Furthermore, the city resilience strategy should define the roles of stakeholders with regards to the implementation of the actions. In addition, the city resilience strategy needs to be aligned with the municipal plans and policies.</p>
LEARNING	<p>3.4 Formalize multi-stakeholder debriefing meetings and learning process.</p> <p>The local government needs to establish regular debriefing meetings that involve different city stakeholders (such as the local government, emergency services, CIs, volunteer organization and academic, educational and scientific entities) to analyze and identify best practices from different types of disasters that occur in the city and in other locations.</p>

5.2.4 Supportive stage

In the *supportive* stage, the local government coordinates the implementation of the resilience strategy and the stakeholders that are responsible for implementing the actions receive incentives such as awards and grants. Furthermore, the local government develops partnerships with the media and sets up mechanisms to disseminate and inform on the progress of the city resilience strategy. The local government also establishes a multi-stakeholder committee to evaluate, improve, and decide the city resilience-building process. Table 5.4 describes the policies included in the *supportive* stage.

Table 5.4: Policies in the *supportive* stage.

SUPPORTIVE STAGE	
AWARENESS	<p>Policy 4.1: Implement mechanisms to disseminate the city resilience strategy.</p> <p>The local government needs to set up mechanisms such as a public communication platform or website to inform the city stakeholders of the city resilience strategy and the actions that are implemented in the city to improve the level of resilience.</p> <p>Policy 4.2: Establish agreements with the media to communicate the city resilience strategy.</p> <p>The local government needs to establish collaboration agreements (such as Public-Private partnerships) with local media channels (i.e. local newspapers, radio, and television) to communicate official information, disseminate the city resilience strategy, and inform on resilience-building activities. The objective is to foster stakeholders' awareness and involvement in the resilience-building process.</p>
	<p>Policy 4.3: Support the implementation of the resilience actions providing incentives.</p> <p>The local government needs to support stakeholders to implement the actions defined in the city resilience strategy. To support the implementation of the actions, the local government needs to provide incentives such as grants and awards to the stakeholders that carry out the actions and take measures to improve the resilience level.</p>
LEARNING	<p>Policy 4.4: Establish a multi-stakeholder committee to monitor the resilience strategy.</p> <p>The local government needs to establish a steering committee with representatives from the local government, the emergency services, CIs, public and private companies, academic, scientific, and educational entities, and the media that meet on a regular basis to monitor the implementation of the city resilience strategy. The steering committee needs to define indicators to verify that the actions described in the city resilience strategy are implemented successfully. Furthermore, the steering committee needs to oversee the involvement of stakeholders for each action, refine and develop new actions and report on their progress.</p>

5.2.5 Proactive stage

In the *proactive* stage, all stakeholders, including citizens and public and private companies, contribute proactively to the resilience-building process. The local government carries out consultation processes where stakeholders provide feedback on the resilience-building process. Furthermore, the local government provides the opportunity for the city stakeholders to participate in public training exercises and it promotes resilience certifications among public and private companies. Finally, the local government supports the collaboration among stakeholders by establishing participatory mechanisms and platforms for mutual learning. Table 5.5 describes the policies included in the *proactive* stage.

Table 5.5: Policies in the *proactive* stage.

PROACTIVE STAGE	
AWARENESS	<p>Policy 5.1: Undertake public consultations to receive feedback on the city resilience strategy.</p> <p>The local government needs to undertake public consultations to provide the opportunity for the city stakeholders to give feedback and suggestions on the city resilience-building process. Public consultations aim at identifying the priorities and the necessities of stakeholders in order to take them into account for future implementation.</p>
PREPAREDNESS	<p>Policy 5.2: Arrange multi-stakeholder training and exercising opportunities to improve joint planning.</p> <p>The local government needs to provide preventive training to city stakeholders to improve their capacity to self-organize and coordinate effectively to manage disasters. With basic training of stakeholders, they can act as first responders at the early stage of an incident such as flooding. Furthermore, citizens can be trained from primary school to deal with disasters.</p> <p>Policy 5.3: Promote resilience certification in companies.</p> <p>The local government needs to promote building resilience among public and private companies by providing resilience certification to those companies that accomplish with the required measures and actions to improve the city resilience level.</p>
LEARNING	<p>Policy 5.4: Establish participatory mechanisms for co-working and exchange of resilience practices among stakeholders.</p> <p>The local government needs to set up platforms such as websites and databases for the different stakeholders to share lessons learned and best practices and learn from each other's experiences. Participatory mechanisms enable stakeholders to interact with each other and work together towards improving the city resilience-building process.</p>

Table 5.6: Stakeholder-collaboration maturity model.

STAGES	UNRECOGNIZED	INITIAL	FORMALIZED	SUPPORTIVE	PROACTIVE
OBJECTIVES	Limited collaboration with stakeholders to manage disasters.	Initiate partnerships with stakeholders to prepare and respond to disasters.	Formalize partnerships with stakeholders to develop a city resilience strategy.	Disseminate the city resilience strategy.	Establish mechanisms for stakeholder co-working in developing city resilience.
STAKEHOLDERS INVOLVED	Emergency services and local government.	CIs, volunteer organizations, citizens and companies in risk-prone areas, emergency services and local government.	Academic, educational and scientific entities, Cls, volunteer organizations and companies in risk-prone areas, emergency services and local government.	Media, academic, educational and scientific entities, Cls, volunteer organizations, citizens and companies in risk-prone areas, emergency services and local government.	Citizens, public and private companies, media, academic, educational and scientific entities, Cls, volunteer organizations, emergency services and local government.
AWARENESS	1.1 Communicate and disseminate potential risks and protection measures.	2.1 Organize informative sessions to provide basic preventive measures to citizens and companies in risk-prone areas.	3.1 Formalize partnerships with academic, educational and scientific entities to organize resilience awareness programs. 3.2 Establish working groups to develop a city resilience strategy.	4.1 Implement mechanisms to disseminate the city resilience strategy. 4.2 Establish agreements with the media to communicate the city resilience strategy.	5.1 Undertake public consultations to receive feedback on the city resilience strategy.
PREPAREDNESS	1.2 Develop agreements with the emergency services to identify, plan, and manage disaster. 1.3 Test disaster plans and arrange training exercises.	2.2 Initiate agreements with the Cls to develop and share disaster plans. 2.3 Initiate partnerships with volunteer organizations to involve them in disaster management.	3.3 Define the roles of the stakeholders to implement resilience actions.	4.3 Support the implementation of the resilience actions and provide incentives.	5.2 Arrange multi-stakeholder training and exercising opportunities to improve joint planning. 5.3 Promote resilience certification in companies.
LEARNING	1.4 Carry out post-disaster evaluation to improve disaster plans.	2.4 Establish procedures and mechanisms to share lessons learned.	3.4 Formalize multi-stakeholder debriefing meetings and learning process.	4.4 Establish a multi-stakeholder committee to monitor the resilience strategy.	5.4 Establish participatory mechanisms for co-working and exchange of resilience practices among stakeholders.

5.3 Stakeholders' roles throughout the maturity stages

Collaboration between the local government and the city stakeholders is crucial in the city resilience-building process. The stakeholder-collaboration maturity model provides local governments with a sequence of policies to improve the collaboration with different city stakeholder groups (emergency services, volunteer organizations, CIs, citizens, public and private companies, media, and academic, educational and scientific entities). The local government is the main driver in the stakeholder-maturity model and needs to take a proactive role throughout the maturity stages. As the local government implements the policies defined in each maturity stage, it manages to collaborate with an increasing number of stakeholders in the resilience-building process.

With regards to the different city stakeholder groups, not all of them have the same responsibilities in the resilience-building process. Table 5.6 includes the stakeholders in the maturity stages in which they have a proactive role in the implementation of the policies. Only in the most advanced maturity stage (*proactive* stage) all the stakeholder groups collaborate with the local government and have a proactive approach in the resilience-building process. The roles of the different group of stakeholders evolve from a more reactive to a more proactive role throughout the stakeholder-maturity model.

Following tables present the evolution of the roles of the different city stakeholders throughout the maturity stages taking into account their contribution to the resilience principles (red for *awareness* principle, green for *preparedness* principle and blue for *learning* principle).

Table 5.7: Role of the emergency services throughout the maturity stages.

ROLE OF THE EMERGENCY SERVICES	
Unrecognized stage	
	Emergency services provide information on potential risks and protection measures to the city stakeholders via their own channels (websites, social media...).
	Emergency services share information with the local government on disasters and potential risks.
	Emergency services collaborate with local governments to develop, test and plans for potential disasters (such as flooding or effects of climate change).
	Emergency services carry out training exercises and drills on a regular basis to test disaster plans with the local government.
	Emergency services carry out an evaluation of past disasters to improve procedures and plans with the local government.
Initial stage	
	Emergency services provide basic prevention training, explain disaster plans and how to evacuate in case of disasters to citizens and companies located in risk prone areas.
	Emergency services share contingency plans, resources, and contact details with the CIs.
	Emergency services carry out training exercises with the local government, volunteer organizations and CIs.
	Emergency services identify, document and share lessons learned after training exercises and disasters with the local government, CIs and volunteer organizations.
Formalized stage	
	Emergency services help academic and educational entities carry out resilience awareness campaigns and programs in schools, neighbourhoods and community organizations.
	Emergency services identify resilience-building actions that need to be included in the city resilience strategy with regards to disaster management.
	Emergency services define the roles of the stakeholders that need to implement the resilience actions defined in the resilience strategy.
	Emergency services share lessons learned and best practices on in regular multi-stakeholder debriefing meetings with volunteer organizations, local government, and CIs.
Supportive stage	
	Emergency services implement the actions defined in the city resilience strategy (such as carrying out multi-stakeholder training exercises and drills).
	Emergency services evaluate the implementation of the resilience-building actions defined in the city resilience strategy in established committees.
Proactive stage	
	Emergency services provide feedback on the resilience strategy in consultation processes.
	Emergency services participate in training exercises and drills with citizens and public and private companies to improve coordination among stakeholders.
	Emergency services share lessons learned, best practices and experiences through online platforms with other stakeholders (such as citizens, CIs...).

Table 5.8: Role of the volunteer organizations throughout the maturity stages.

ROLE OF THE VOLUNTEER ORGANIZATIONS	
Unrecognized stage	
	Volunteer organizations provide information on potential risks and protection measures to the citizens via their own channels (websites, social media...).
Initial stage	
	Volunteer organizations help emergency services to provide basic prevention training and explain disaster plans to citizens and companies located in risk-prone areas.
	Volunteer organizations participate in training exercises with emergency services, local government and CIs.
	Volunteer organizations identify, document and share lessons learned in debriefing meetings after disasters with the emergency services and the local government.
Formalized stage	
	Volunteer organizations identify resilience-actions (such as volunteering opportunities and events) and define the objectives of the city resilience strategy.
	Volunteer organizations share lessons learned and best practices on different types of disasters in regular multi-stakeholder debriefing meetings with emergency services, local government, and CIs.
Supportive stage	
	Volunteer organizations implement actions defined in the city resilience strategy (such as providing training to vulnerable population) with incentives from the local government.
	Volunteer organizations evaluate the implementation of the actions defined in the city resilience strategy in established committees.
Proactive stage	
	Volunteer organizations provide feedback on the resilience strategy in consultation processes.
	Volunteer organizations participate in training exercises and drills with citizens and public and private companies to improve coordination among stakeholders.
	Volunteer organizations share lessons learned, best practices and experiences through online platforms with other stakeholders (such as citizens, CIs...).

Table 5.9: Role of the academic, educational and scientific entities throughout the maturity stages.

ROLE OF THE ACADEMIC, EDUCATIONAL, AND SCIENTIFIC ENTITIES	
Unrecognized stage	
	Academic entities are provided information on disasters, potential risks and protection measures from the emergency services and local government.
Initial stage	
	Academic entities carry out research on climate change adaptation and disaster management without coordination with other city stakeholders.

Formalized stage	
	Academic and educational entities carry out awareness programs to promote resilience-building in schools, universities, neighbourhoods and among the scientific community.
	Academic entities participate in working groups to identify resilience-actions and define the objectives of the city resilience strategy.
Supportive stage	
	Academic entities implement the actions defined in the city resilience strategy (such as analysis of resilience-building policies) with incentives provided by the local government.
	Academic entities monitor the implementation of the resilience actions defined in the city resilience strategy in established committees.
Proactive stage	
	Academic entities provide feedback on the resilience strategy in consultation processes.
	Academic entities implement resilience-building actions with the incentives and grants provided by the local government.
	Academic entities participate in public training exercises to improve coordination with city stakeholders.
	Academic entities share lessons learned, best practices and experiences through online platforms with other stakeholders (such as citizens, CIs...).

Table 5.10: Role of the media throughout the maturity stages.

ROLE OF THE MEDIA	
Unrecognized stage	
	The media informs citizens via different channels (i.e. television and radio channels, newspapers, and social media) when disasters occur.
Initial stage	
	The media receives information on potential disasters and protection measures from the local government and emergency services.
Formalized stage	
	The media shares information on resilience-awareness activities carried out by volunteer organizations, CIs, academic, educational and scientific entities.
Supportive stage	
	The media promotes the dissemination of the city resilience strategy.
Proactive stage	
	The media provides feedback on the resilience strategy and promotes the consultation process among city stakeholders.
	The media participates in public training exercises to improve coordination with city stakeholders.
	The media shares lessons learned, best practices and experiences through online platforms with other stakeholders (such as citizens, CIs...).

Table 5.11: Role of the CIs, public and private companies throughout the maturity stages.

ROLE OF THE CIs, PUBLIC AND PRIVATE COMPANIES	
Unrecognized stage	
	CIs share information with the local government on disasters and potential risks.
Initial stage	
	CIs share contingency plan, resources, contact lists with the emergency services and local government.
	CIs comply with legislation on disaster management such as by developing contingency plans to ensure essential services in case of disasters.
	CIs participate in training exercises with the local government, emergency services and volunteer organizations.
Formalized stage	
	CIs organize awareness activities to foster a resilience culture within the organization (such as training courses).
	CIs participate in working groups to identify actions and define the objectives of the city resilience strategy (such as identification of interdependencies across CIs).
	CIs share lessons learned and best practices in regular multi-stakeholder debriefing meetings with volunteer organizations, local government, and emergency services.
Supportive stage	
	CIs implement actions defined in the city resilience (such as analysis of cascading effects across critical service providers).
	CIs evaluate the implementation of the resilience-building actions defined in the city resilience strategy in established committees.
Proactive stage	
	Public and private companies and CIs provide feedback on the resilience strategy in consultation processes.
	Public and private companies implement actions (such as training courses and awareness programs) with the incentives and grants provided by the local government.
	Public and private companies and CIs participate in public training exercises to improve coordination with city stakeholders.
	Public and private companies and CIs acquire certification on resilience procedures.
	Public and private companies and CIs share lessons learned, best practices and experiences through online platforms with other stakeholders (such as other CIs).

Table 5.12: Role of the citizens throughout the maturity stages.

ROLE OF THE CITIZENS	
Unrecognized stage	Citizens are provided information on disasters, potential risks and protection measures from the emergency services and local government.
Initial stage	Citizens located in risk-prone areas attend informative sessions to learn procedures and how to react in case of disasters. They also receive basic prevention training (i.e. identify safe places, and provide protection measures).
Formalized stage	Citizens attend awareness sessions, campaigns and local conferences to increase understanding on the city resilience-building process.
Supportive stage	Citizens access the municipal platform to read the resilience plan and the actions that are being implemented to build city resilience.
Proactive stage	Citizens provide feedback on the resilience strategy in consultation processes.
	Citizens participate in public training exercises to improve coordination with city stakeholders.
	Citizens implement resilience actions with the incentives and grants provided by the local government (such as development of household disaster plans).
	Citizens upload best practices and share experience on resilience actions with other citizens through online platforms.
	Citizens evaluate the implementation of the actions defined in the city resilience strategy in established committees.

At the *unrecognized* stage, the local government only collaborates with the emergency services in the identification, preparation, and response of foreseen disasters. At this stage, the local government has not yet developed a holistic approach to collaborate with city stakeholders in the resilience-building process. Furthermore, at this stage, citizens feel that disaster management is a responsibility of the local government and the emergency services.

At the *initial* stage the local government and the emergency services collaborate with citizens and companies located in risk-prone areas in order to improve their capacity to deal with disasters. Also at the *initial* stage, the local government collaborates with representatives of CIs and volunteer organizations to share information about potential disasters and issues related

to preparedness and the safety of the city.

At the *formalized* stage, the local government arranges resilience awareness activities to share information and knowledge about preparedness and disaster management. These activities contribute to the exchange of information and identification of possible synergies among city stakeholders. Also at the *formalized* stage, the local government starts to share information and collaborate more frequently with stakeholders from different disciplines such as academic, educational and scientific entities.

At the *supportive* stage, the local government establishes multi-stakeholder collaboration groups made up of representatives from the different local government departments, the emergency services, volunteer organizations, CIs, academic, scientific and educational entities, and the media. However, at this stage collaboration with citizens and companies in the city resilience-building process is limited.

Finally, in the *proactive* stage, all the stakeholder groups have an active role in the resilience-building process. At the *proactive* stage, the local government establishes multi-stakeholder committees to involve representatives from all city stakeholders (including citizens and public and private entities) to reflect upon and make decisions about the progress of city resilience. Also, the local government arranges consultation process for the citizens to participate and contribute to the resilience-building process. Thus, at this stage the city stakeholders are proactive and do not only receive but also provide information.

5.4 Indicators for assessing the implementation of the policies

An assessment of the city resilience level is valuable information when planning, coordinating, and directing strategies and resources (Singh-Peterson et al., 2014). The measurement of resilience using indicators is a new and rapidly developing area of research and practice (Bahadur et al., 2015). An indicator is a quality or trait that suggests effectiveness, progress or success (Arnott et al., 2016). Indicators can assist local government in assessing and prioritizing goals

and can be useful in establishing baselines for monitoring progress and recognizing success (Cutter, 2016).

Within the academic literature, there are several studies that propose indicators for measuring city resilience (Cutter et al., 2008, Cutter et al., 2014, Kusumastuti et al., 2014, Singh-Peterson et al., 2015, UNISDR, 2015b). These studies present static indicators that estimate the resilience level of a city using a numeric value. However, there is no consensus on the wide range of indicators that should be measured to be taken into account to evaluate the resilience level of a city (Cutter et al., 2014). The limited consensus on what should be measured, using what variables, and for what purpose, provides limited guidance for cities (Cutter, 2016). Furthermore, existing studies that propose city resilience indicators do not provide measurement for evaluating the level of collaboration between city stakeholders.

In view of these gaps, this research proposes a set of indicators for the local government to assess the collaboration with the city stakeholders in the resilience-building process. The proposed indicators are intended to provide data that will help local government to evaluate the policies provided in the stakeholder-collaboration maturity model. Table 5.13 presents a set of indicators for measuring the indicators classified according to the resilience principles (*awareness, preparedness and learning*). Furthermore, the source of the indicators that were obtained from the literature studies is presented.

Table 5.13: Indicators.

INDICATOR	DEFINITION	POLICY	SOURCE
Resources for awareness programs	Resources allocated by the local government to carry out resilience awareness programs and informatory sessions. Units: Time, euros or persons/month.	2.1, 3.1	Kusumastuti et al. (2014)
Resources for informative channels	Resources allocated by the local government to establish and update channels (i.e. websites, platforms) to inform on disasters and resilience-building. Units: Time, euros or persons/month.	1.1, 4.1	UNISDR (2015b)

AWARENESS	Number of participants in awareness programs	Number of participants involved in resilience awareness programs such as campaigns, workshops, and informatory sessions. Units: percentage of citizens.	2.1, 3.2	Cutter et al. (2014) Kusumastuti et al. (2014) UNISDR (2015b)
	Frequency of awareness meetings	Number of meetings (campaigns, informatory sessions, workshops, and programs) arranged to raise awareness during a specific period of time (such as a year). Units: number of meetings per time.	2.1, 3.2	Singh-Peterson et al. (2015)
	Percentage of population consulted	Percentage of population that participate in consultation processes to provide feedback on the city resilience-building process. Units: percentage of population.	5.1	
	Number of followers	Number of followers subscribed to informatory channels and communication tools about resilience. Units: number of followers.	4.1	
	Number of collaboration agreements	Number of agreements between the local government and stakeholders (i.e. academic and educational entities, volunteer organizations, media) to carry out informatory sessions or education programs in schools. Units: number of agreements.	3.1, 4.2	
PREPAREDNESS	Resources for training	Resources allocated by the local government to develop and implement disaster plans and training exercises. Units: Time, euros or persons/month.	1.3, 5.2	Kusumastuti et al. (2014) UNISDR (2015b)
	Number of stakeholders that share plans	Number of stakeholders (such as companies and CIs) that share their disaster plans with the local government and emergency services. Units: percentage of companies.	1.2, 2.2, 2.3	Cutter et al. (2014)
	Percentage of population that receive incentives	Percentage of population that receive incentives such as grants, awards, or certifications to implement resilience actions. Units: percentage of population.	4.3, 5.3	UNISDR (2015b)
	Degree of implementation of the plan	Status of the city resilience strategy and the actions defined in the plan (developed, published, implemented or monitored). Units: from 0 to 100 %.	3.3	Cutter et al. (2008)

	Frequency of training exercises	Number of multi-stakeholder training exercises and drills carried out in the city during a specific duration of time (such as a year). Units: number of exercises per time.	1.3, 5.2	UNISDR (2015b)
	Percentage of population trained	Percentage of population that has been reached through training exercises and drills. Units: percentage of population.	5.2	Cutter et al. (2014) Kusumastuti et al. (2014)
LEARNING	Resources for debriefing meetings	Resources allocated by the local government to arrange multi-stakeholder meetings to monitor the resilience-building process. Units: Time, euros or persons/month.	1.4, 3.4	
	Resources for lessons learned platforms	Resources allocated by the local government to establish and update platforms, tools and websites for city stakeholders to document and exchange resilience lessons learned. Units: Time, euros or persons/month.	2.4, 5.4	
	Number of participants in debriefing meetings	Number of participants in debriefing meetings arranged by the local government to evaluate the city resilience strategy implementation. Units: Number of participants.	1.4, 3.4	UNISDR (2015b)
	Frequency of debriefing meetings	Number of multi-stakeholder meetings arranged to monitor the city resilience strategy during a specific duration of time (such as a year). Units: Number of meetings per time.	1.4, 3.4	UNISDR (2015b)
	Number of lessons learned implemented	Number of resilience lessons learned implemented at the city with respect to the lessons learned identified in multi-stakeholder debriefing meetings and resilience platforms. Units: Number of lessons learned implemented/lessons learned identified.	2.4, 5.4	

5.4.1 Analysis of the usefulness of the indicators

In order to validate the proposed indicators, a survey was carried out with 11 city representatives from the cities of Rome (Italy), Kristiansand (Norway), Vejle (Denmark), Donostia/ San Sebastián (Spain), Bristol and Glasgow (UK). The participants in the survey were asked to evaluate the indicators for assessing the collaboration between the local government and stakeholders in awareness,

preparedness, and learning processes within the city. A four level Likert-type scale (4-Strongly agree; 3-Agree, 2-Disagree; 1-Strongly Disagree; 0-Don't know) was provided to determine to what extent they agree or disagree with the usefulness of these indicators. Furthermore, the participants were asked to provide information on the indicators that are used in their cities to evaluate the resilience-building process.

With regards to the usefulness of the awareness indicators, all of them obtained an average score greater than 3 out of 4 (see Figure 5.1). According to the participants in the survey, *the resources for informative channels* (with an average score of 3.4 out of 4) is the most useful indicator. The resources (such as persons in charge and time spent within the City Council) allocated to establish and update informative channels increases the information available on the resilience-building process and therefore, improves stakeholders' level of awareness. However, this indicator is only implemented in the city of Glasgow. According to the city representatives, the reason for the limited implementation of this indicator in the cities is the difficulty in obtaining the overall resources allocated to the variety of informative channels that are in place.

With regards to the awareness indicators used in the cities involved in the survey, *the frequency of awareness meetings* is the only indicator monitored by in the six cities. For instance, the cities of Glasgow and Donostia/ San Sebastián gather information on the frequency of meetings as well as the range of citizens that attend local community council meetings. Furthermore, the *number of collaboration agreements* is currently used in four of the six cities (Kristiansand, Glasgow, Rome and Vejle). According to participants in the survey, in addition to the number of collaboration agreements, it would be important to measure the quality of these partnerships.

As an additional indicator, participants in the survey suggested evaluating the number of initiatives for building city resilience that come from citizens. Participants also proposed an indicator to monitor the number of official communication made by the local government regarding the resilience-building process.

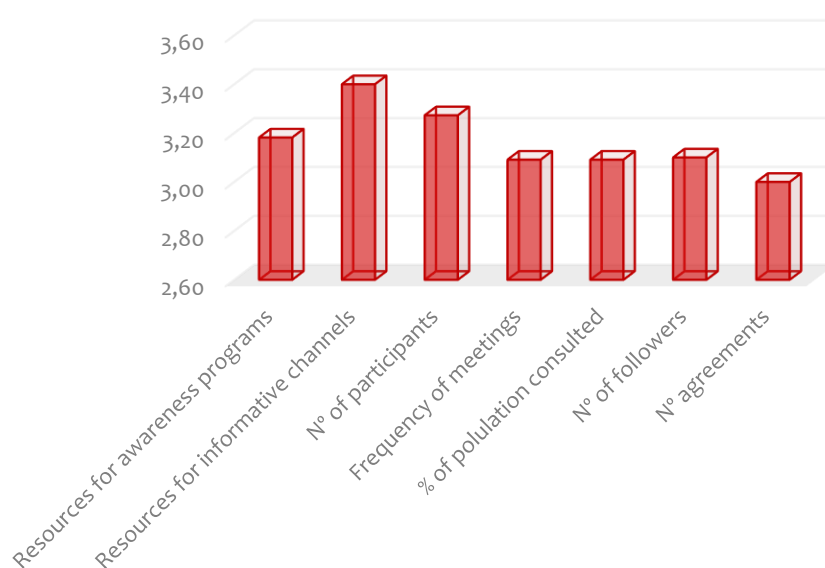


Figure 5.1: Awareness indicators.

With regards to the preparedness indicators, all of the indicators within this principle except for *the percentage of population with incentives* (with an average score of 2.67 out of 4) have an average score greater than 3 out of 4 (see Figure 5.2). According to participants, providing incentives does not necessarily contribute to improving the collaboration of stakeholders in preparedness processes. In this vein, none of the six cities involved in the survey implement this indicator.

Based on the obtained results, *the frequency of training exercises* indicator (with an average score of 3.45 out of 4) is the most useful indicator to evaluate the city preparedness level. According to the participants, it is important to carry out regular training and disaster exercises in the absence of disasters to enhance the coordination and foster synergies among different entities involved in the resilience-building process. This indicator is currently being used in the six cities involved in the survey.

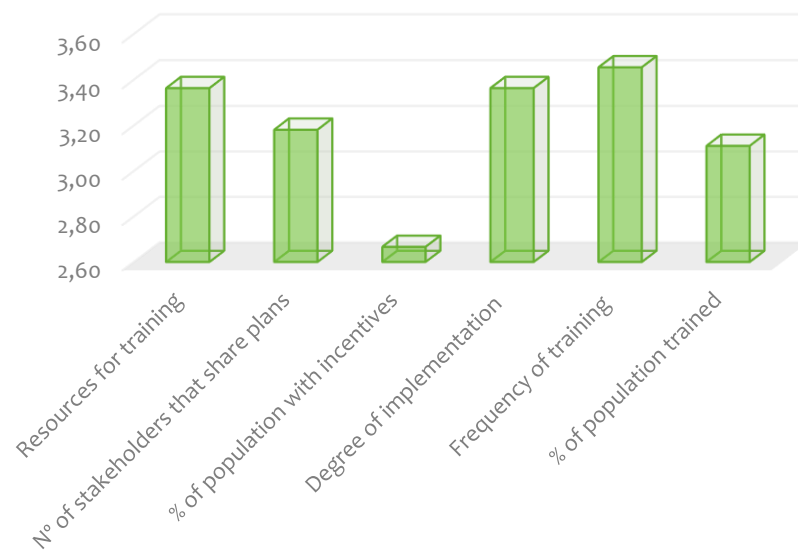


Figure 5.2: Preparedness indicators.

With regards to the learning indicators, all of the proposed indicators have an average score greater than 3 (out of 4) (see Figure 5.3). According to the participants, *the percentage of number of participants in debriefing meetings* (with a score of 3.22 out of 4) and *the frequency of debriefing meetings* (with a score of 3.11 out of 4) are the most useful indicators. The representation of different city stakeholders in debriefing meetings provides opportunities to share experiences, lessons learned and best practices taking into account the different points of view of the involved stakeholders. This indicator is used in all the cities involved in the survey. For instance, the firefighter service from the city of Donostia/ San Sebastián keeps track on the weekly debriefing meeting in which the members of the staff analyze together the emergencies and disasters which they have managed.

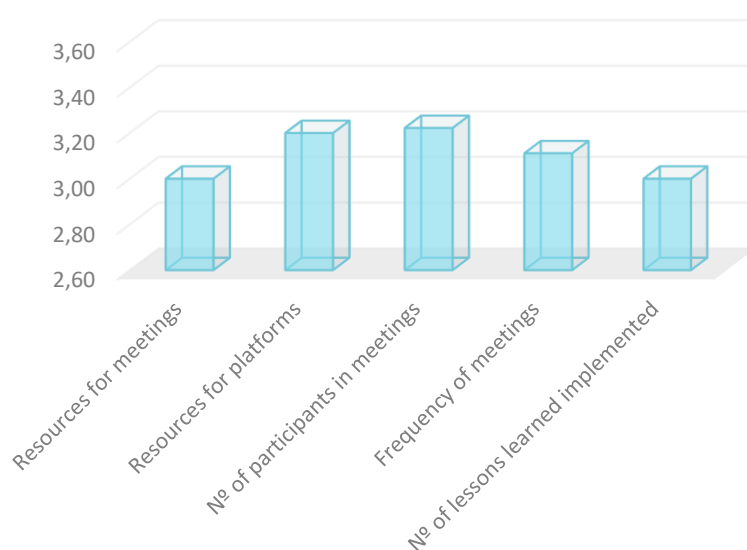


Figure 5.3: Learning indicators.

5.4.2 Discussion on the indicators

Although this research proposes a set of indicators that help to evaluate the implementation of the policies, these indicators are limited in various ways. A general concern among the participants in the survey is the lack of qualitative indicators for evaluating stakeholders' collaboration in the resilience-building process. According to the participants, it is important to use indicators that evaluate quantitative information such as the frequency of meetings and the number of stakeholders involved. However, it is also necessary to use indicators that evaluate the quality of the actions implemented by the local government to improve collaboration with city stakeholders.

Furthermore, another limitation of the proposed indicators is their practical implementation. Representatives from different cities stated that the application of indicators in cities is limited because no specific resources are allocated to evaluate and monitor stakeholders' collaboration in the resilience-building process. In this vein, it is currently a challenge for local government to establish a common set of indicators for benchmarking and monitoring across cities.

5.5 Implementation of the stakeholder-collaboration maturity model

The stakeholder-collaboration maturity model provides a reference model for local governments to improve collaboration with city stakeholders. The stakeholder-collaboration maturity model proposes a sequence of maturity stages and policies and the temporal order in which the local governments need to implement them to improve progressively the collaboration with city stakeholders. Although not every city will be initially at the first stage, the maturity stages are meant to be taken in the proposed order.

The implementation of the stakeholder-collaboration maturity model consists of an iterative methodology that includes four steps. The results of each step is the input for the following step, therefore, the proposed four steps should be carried out in the proposed order.

1. Analysis of the implemented policies: the analysis consists of collecting and gathering data and evidence of the policies implemented to date by the local government to improve the collaboration with the city stakeholders. In order to gather evidence of the policies, surveys, interviews and consultation processes need to be undertaken with city stakeholders.
2. Self-assessment of the current maturity stage: once the policies that have been implemented to date in the city are identified, the local government needs to check the objectives and policies described in each stage of the stakeholder-collaboration maturity model. Based on this information, it can assess the current maturity stage of the city for each resilience principle (*awareness, preparedness and learning*).
3. Identification of future steps: once the current maturity stage of the city has been established, the stakeholder-collaboration maturity model provides a roadmap to identify areas in need of improvement and guidance to prioritize which policies should best be implemented. In addition to implementing new policies, the local

government should continue implementing the policies already fulfilled in the previous stages.

4. Monitoring: the implementation of the policies needs to be monitored. The indicators included in the stakeholder-collaboration maturity model help to assess the evolution of the implementation of the policies by identifying the number of stakeholders involved and the frequency of implementation of the policies.

Finally, it should be taken into account that although each stage of the stakeholder-collaboration maturity model represents a generic characterization that could be applied to any city, the success of the implementation of the policies, and the time that a city may spend at each stage depend on a variety of factors such as government' commitment, regulation and legislation in place, and geographic location of cities.

- Government commitment: the local government is a key element in the resilience-building process. Committed local governments guarantee that resources are allocated to establish partnerships and collaboration opportunities across stakeholders.
- Regulation and legislation in place: national, regional and local regulation on disaster management and resilience contributes to the establishment of partnerships between specific city stakeholders in order to comply with legislation.
- Geographical location: the geographic location of a city can influence the probability of suffering specific disasters such as rising sea level, earthquakes or flooding. Therefore, stakeholders located in cities exposed to specific disasters may have more experience in collaborating with each other.

5.6 Conclusions

The stakeholder-collaboration maturity model describes a sequence of five maturity stages (*unrecognized, initial, formalized, supportive* and *proactive*) and the policies that need to be implemented at each maturity stage. The sequence of maturity stages and policies outlined in the stakeholder-collaboration maturity model provides guidance for the local governments to improve progressively the collaboration with city stakeholders in the resilience-building process. Moreover, the stakeholder-collaboration maturity model provides indicators to help the local government to evaluate the level of implementation of the policies included in the maturity stages.

The stakeholder-collaboration maturity model takes as a basis that building resilient cities requires the collaboration of a wide variety of city stakeholders including the local government, emergency services, citizens, volunteer organizations and public and private companies. In this vein, the policies included in the stakeholder-collaboration maturity model (such as carrying out debriefing meetings, developing partnerships, involving stakeholders in disaster exercises...) do not assume that all the citizens and all stakeholder groups share the same concerns in each city, but propose a mean for these stakeholders to come together, develop common awareness and improve their preparation and learning. Furthermore, the stakeholder-collaboration maturity model recognizes that the responsibilities and roles of the different city stakeholders vary. In line with this, it presents the evolution of the roles and responsibilities of the stakeholders thorough the maturity stages.

Finally, an implementation methodology has been developed to help local governments to use the stakeholder-collaboration maturity model as a reference model to decide the most effective steps to improve progressively the collaboration with the different groups of city stakeholders.

6

Case Studies

This section presents two case studies that were carried out in this research to implement the stakeholder-collaboration maturity model. The aim of the case studies was to gather evidence of the policies implemented by the local government in order to improve the collaboration with city stakeholders in the resilience-building process. This information allowed to verify that the sequential order of stages and policies defined in the stakeholder-collaboration maturity model help to improve progressively the collaboration between the local government and city stakeholders.

Furthermore, the stakeholder-collaboration maturity model was useful to provide cities under study with improvement areas and recommendations to increase the collaboration between the local government and city stakeholders. Finally, the challenges encountered in the cities with regards to the collaboration of city stakeholders and recommendations to overcome them are presented.

6.1 Results from the case studies

The stakeholder-collaboration maturity model developed in this research proposes a sequence of maturity stages and policies and the temporal order in which they need to be implemented to improve the collaboration between the local government and city stakeholders. In order to implement the stakeholder-collaboration maturity model, two case studies were carried out in two cities committed to improving their resilience level. Cities committed to improving the city resilience level can provide the information required to identify the steps and milestones along the road to advanced stages of the stakeholder-collaboration maturity model.

The first case study was carried out in Glasgow (United Kingdom). The city of Glasgow is recognized for its commitment to becoming a resilient city by different international projects such as the 100 Resilient Cities from the Rockefeller Foundation and Smart Mature Resilience European Project. Furthermore, the city of Glasgow has been the first city in the United Kingdom to develop, launch, and implement a city resilience strategy.

The second case study was carried out in the city of Donostia/San Sebastián. This city of Donostia/San Sebastián has a huge in experience dealing with flooding events and is involved in international networks of resilience cities such as the Smart Mature Resilience European project and Covenant of Mayors for Climate and Energy. However, the city of Donostia/San Sebastián has yet not developed a city resilience strategy.

During both case studies, an implementation questionnaire was used with a set of questions and issues that needed to be explored with different city stakeholders. The questions included in the implementation questionnaire aim at gathering evidence of the policies implemented in the cities under study in order to assess their current maturity stage. The implementation questionnaire can be found in Appendix F.

Based on the information obtained from the case studies, it was possible to verify evidence of the sequential order of policies proposed in the stakeholder-collaboration maturity model and assess the current maturity stage of the cities

under study. Following, the evidence of the policies accomplished in both cities for each maturity stage is presented. Furthermore, the stakeholders involved in each policy are described.

6.2 Case study in the city of Glasgow

The city of Glasgow is located in the United Kingdom and is characterized by its industrial background. Glasgow has been affected by significant flooding in the recent past years with severe consequences for communities in some of the most deprived areas of the city. Flooding has affected the city with large-scale disruption to overland and underground rail networks and roads. Furthermore, the city is facing an increasing number of risks associated with weather (such as increases in rainfall, temperatures and severe weather events) due to climate change. Following, the evidence of the policies implemented in the city of Glasgow are described.

6.2.1 Unrecognized stage

In the city of Glasgow there is a department of the City Council that works on sustainability and climate change adaptation (Sustainability department) and a department that works on disaster management (Civil Protection department). The Sustainability department is in charge of informing, preparing, and planning for the effects of climate change in the city. The Civil Protection department works with the entities from the emergency services (i.e. the police, the fire and rescue systems, and the health services) to inform, prepare, and plan for disasters.

Prior to 2011, a holistic resilience approach that integrated collaboration opportunities between the local government and city stakeholders (i.e. citizens, business) to improve the city resilience level was lacking. The departments from the City Council limited to collaborate with the entities from the emergency services in the identification of potential risks and in development of disaster plans. However, no further stakeholders were involved in the city resilience-building process. Following, Table 6.1 describes the evidence of the policies of the *unrecognized* stage for the city of Glasgow.

Table 6.1: Evidence for the *unrecognized* stage.

UNRECOGNIZED STAGE (until 2011)	
AWARENESS	<p>Policy 1.1: Communicate and disseminate potential risks and protection measures.</p> <p>Glasgow City Council has a central press and media office in charge of providing relevant information to the media channels (such as the BBC television, local newspapers and radio channels) on risk warnings and disaster in order to reach a broad audience. Furthermore, the emergency services, such as the police, the Scottish fire and rescue services, and the health services have their own channels (Twitter, Facebook and websites) to inform and advise citizens of disasters as well as give information on risk warnings.</p>
PREPAREDNESS	<p>Policy 1.2: Develop agreements with emergency services to identify, plan, and manage disasters.</p> <p>In 2004 the Civil Contingencies Act¹ was put into effect in the whole United Kingdom in order to establish a statutory framework that defines the roles of the local and governmental agencies and the responsibilities of the stakeholders of the disaster planning system. According to the Civil Contingencies Act, the emergency services and the local authorities are required to assess the risk of disasters and use this information to develop contingency plans. Furthermore, they are required to share information and cooperate with the emergency services. In the city of Glasgow, the emergency services including the Scottish fire and rescue service, the Scottish Ambulance Service and health boards are coordinated by the police Scotland with assistance from the Civil Protection department from the City Council. The Civil Protection department provides a single point of contact between the emergency services and all City Council departments to ensure services are able to operate and recover quickly when they are affected by disasters such as flooding.</p> <p>Policy 1.3: Test disaster plans and arrange training exercises.</p> <p>The Civil Protection department of Glasgow City Council is in charge of planning for major disasters by writing disaster and contingency plans. According to the requirements of the Civil Contingencies Act (2004), the Civil Protection department arranges two disaster drills every year at the city level. These drills involve the different departments of the City Council and the police Scotland, Scottish fire and rescue services, and health services.</p>
LEARNING	<p>Policy 1.4: Carry out post-disaster evaluation to improve disaster plans.</p> <p>The Civil Protection department of Glasgow City Council plans for major disasters by writing contingency plans. Each of these plans are tested and afterwards, a debriefing meeting is established with the emergency services to identify issues, improvement points and refresh and update disaster plans and procedures. After two weeks, a report with a list of improvement actions is provided to the emergency services to receive their feedback.</p>

¹ http://www.legislation.gov.uk/ukpga/2004/36/pdfs/ukpga_20040036_en.pdf

6.2.2 Initial stage

In 2011, the Sustainability department, the Civil Protection department and other departments from the City Council (i.e. Development and Regeneration services) started to work together to identify resilience-building activities (i.e. training exercises and disaster plans, partnerships with the emergency services) that were carried out within the city. This was the first step in bringing together representatives from different stakeholders who had already carried out resilience activities. However, collaboration at this stage was still incipient and the actions and collaboration opportunities that need to be established among stakeholders for improving the city resilience level needed to be defined and developed. Following, Table 6.2 describes the evidence of the policies in the city of Glasgow for the *initial* stage.

Table 6.2: Evidence for the *initial* stage.

INITIAL STAGE (2011 - 2014)	
AWARENESS	<p>Policy 2.1: Organize informative sessions to provide basic preventive measures to citizens and companies in risk-prone areas.</p> <p>The Scottish Environment and Protection Agency is an authority of the Scottish Government for flood forecasting, flood warning and strategic flood risk management. The Scottish Environment and Protection Agency was established in 1996 and is responsible for the protection of the natural environment, the identification of areas that may tend to flood and monitoring, and recording water levels on lochs, rivers and coastlines. In March 2011, the Environmental and Protection Agency launched a mobile service (Floodline service²) to provide citizens, whose property is within an area covered by a flood monitoring system, a targeted flood warning message for the specific geographical area. In addition to this service, the Civil Protection department has a contact list of companies that are located at flood risk-prone areas to inform them about specific measures that affects them directly.</p>

² <http://floodline.sepa.org.uk/floodingsignup/>

PREPAREDNESS	<p>Policy 2.2: Initiate agreements with the CIs to develop and share disaster plans.</p> <p>In the city of Glasgow, there are a number of liaison groups whereby CI representatives meet with a view to cooperate with the City Council such as the “Metropolitan Glasgow drainage partnership”. In order to avoid continual flooding from the Clyde river, the “River flood prevention scheme³” was developed in October 2011. This plan led to the creation of a strategic drainage partnership, which is formed by organizations involved in the operation and provision of new and existing sewerage and drainage networks within the city (i.e. the City Council, the Scottish Environmental and Protection agency, local emergency services, the local water agency, regional canals, the local rail network companies and representatives from citizens) to specifically look at flooding across the city.</p> <p>Policy 2.3: Initiate partnerships with volunteer organizations to involve them disaster management.</p> <p>The Civil Contingencies department as required by the Civil Contingencies Act, has established partnerships with voluntary agencies (such as the Red Cross and Scottish ambulance service) to coordinate their involvement in the response to disasters and invite them to participate in training exercises and drills.</p> <p>With regards to climate change adaptation, Glasgow City Council collaborates with different volunteer groups. For instance, there is a utility and transport service provider group, which is ran by the Land and Environmental services department from the City Council that meets with volunteer organizations once per month to review environmental plans.</p>
LEARNING	<p>Policy 2.4: Establish procedures and mechanisms to share lessons learned.</p> <p>In 2012, the Scottish guidance on resilience⁴ was published. The guidance sets out the principles and practices to build resilience and readiness to deal with disasters within Scotland. The guideline establishes procedures for developing and documenting a training and briefing programme for stakeholders (including emergency services and responders from critical companies and voluntary sectors). Furthermore, it defines a procedure for updating and maintaining plans to ensure that stakeholders reflect any changes in disaster assessments, lessons identified and learned from exercises and disasters.</p>

6.2.3 Formalized stage

In 2014, Glasgow City Council got involved in the 100 Resilient Cities. Furthermore, a Chief Resilience Officer (CRO) was appointed in the City Council to lead on the city’s resilience efforts. As well as the CRO, a Resilient

³ <http://www.glasgow.gov.uk/CHttpHandler.ashx?id=2140>

⁴ <http://www.gov.scot/Resource/0038/00389881.pdf>

team from the City Council was assigned responsible for supporting and developing a city resilience strategy.

Also at this time, multi-stakeholder working groups were established to develop the Glasgow resilience strategy. Members of the resilience working groups met once per two months and involved representatives from the emergency services, local politicians, council officials, and representatives from CIs (i.e. health, water, power and energy networks, and environment and protection agency). This was the first time people from the different City Council departments and external stakeholders from the City Council came together to set objectives and develop a city resilience strategy. However, at this point, the city resilience strategy needed to be implemented and citizens and companies needed to be involved in the implementation of the city resilience strategy. Following, Table 6.3 describes the evidence of the policies in the city of Glasgow for the *formalized* stage.

Table 6.3: Evidence for the *formalized* stage.

FORMALIZED STAGE (2014 - 2016)	
AWARENESS	<p>Policy 3.1: Formalize partnerships with academic, educational and scientific entities to organize resilience awareness programs</p> <p>During the development of Glasgow resilience strategy (from October 2014 to September 2015) the City Council established partnerships with academic and research centers such as Strathclyde University, University of Glasgow, and the research Centre for Population Health in order to involve scientific and academic experts in the planning of the city resilience strategy. Through these partnerships, public surveys and discussion forums were arranged from October 2014 to September 2015. During these exercises, a total of 300 participants were asked to reflect on the actions to improve the city resilience level.</p>
	<p>Policy 3.2: Establish working groups to develop a city resilience strategy.</p> <p>From October 2014 to September 2015, 12 multi-disciplinary workshops were held with nine stakeholder groups to work on agreeing on the content of the city resilience strategy and set objectives and actions to build city resilience. The participants included the Glasgow disability alliance, the Glasgow council for voluntary sector, west of Scotland religious equality council and Glasgow homelessness network.</p>

PREPAREDNESS	<p>Policy 3.3: Define the roles of the stakeholders to implement resilience actions.</p> <p>Glasgow resilience strategy⁵ was developed from October 2014 to September 2015. The strategy consists of a wide document reflecting multi-stakeholder input in order to act as a roadmap to bring together aspects of Glasgow City Council’s strategic plan, the strategy of Glasgow to tackle poverty, and the urban development plan to improve the city resilience level towards disasters. Glasgow resilience strategy defines the actions that need to be implemented in the city in the short, medium and long term with the objective to improve the city resilience level. Furthermore, the strategy defines the stakeholders that need to be involved in the implementation of the actions. By aligning the city resilience strategy to the city context, the City Council ensures the city resilience strategy is integrated into an existing framework and adds value to the city.</p>
LEARNING	<p>3.4 Formalize multi-stakeholder debriefing meetings and learning process on disasters.</p> <p>In November 2014, a multi-stakeholder committee (the Resilient Steering Group) was established by the City Council. The Resilient Steering Group met once per two months from November 2014 to September 2016 to reflect and direct the progress of the city resilience-building process based on stakeholders’ input and lessons learned. Members of the Resilient Steering Group involved the Sottish fire and Rescue Services, the police Scotland, representatives from Glasgow City Council and the Scottish Government, representatives from CIs (i.e. Scottish Water, Scottish Power Energy Networks health, the Environment and Protection agency), and representatives from Strathclyde University, University of Glasgow, Glasgow Center for Population Health and the Glasgow Chamber of Commerce.</p>

6.2.4 Supportive stage

In 2016, the city resilience strategy was presented to the public and the resilience activities defined in the strategy started to be implemented by the City Council. Furthermore, Glasgow City Council established a resilience public website and arranged informative sessions to disseminate the activities defined in the city resilience strategy. A multi-stakeholder committee was also established to involve relevant stakeholders such as CIs, universities, research centers and voluntary agencies in the evaluation and decision making process of the resilience-building process. However, at this point, the City Council lacked to collaborate with the local business and citizens in the resilience-building

⁵ <http://www.100resilientcities.org/strategies/city/glasgow>

process. Following, Table 6.4 describes the evidence of the policies in the city of Glasgow for the *supportive* stage.

Table 6.4: Evidence for the *supportive* stage.

SUPPORTIVE STAGE (2016 - currently)	
AWARENESS	<p>Policy 4.1: Implement mechanisms to disseminate the city resilience strategy.</p> <p>In September 2016 a municipal public website⁶ was established to provide information on the city resilience strategy and the resilience actions that take place across the city. Furthermore, the resilient team from the City Council arranges every month since September 2016 public sessions with citizens on the different topics included in the resilience strategy. The topics of the sessions include community resilience, resilience in schools, volunteering, community empowerment, health and wellbeing...</p> <p>Policy 4.2: Establish agreements with the media to communicate the city resilience strategy.</p> <p>The local media channels have been invited to be part of the Resilient Steering group and participate in the meetings on the resilience-building process. However, further agreements need to be established with the media to contribute to the dissemination of the resilience strategy and actions that are being carried out by the different city stakeholders.</p>
	<p>Policy 4.3 Support the implementation of the resilience actions providing incentives.</p> <p>Not yet implemented.</p>
LEARNING	<p>Policy 4.4: Establish a multi-stakeholder committee to monitor the resilience strategy.</p> <p>The Resilient Forum was established by the City Council in 2016. The Resilient Forum is a working group, which involves individuals from across the City Council departments and external stakeholders (representatives from volunteer organizations, universities, research centers and critical services) with special interests, experience and knowledge in city resilience. The remit of the Resilient Forum is to monitor the implementation of the resilience strategy, evaluate the progress as well as promote activities to build resilience and disseminate learning at a citywide level. In order to monitor the resilience strategy, the Resilient Forum has defined a list of indicators to evaluate the implementation of the resilience actions.</p>

⁶ <http://www.resilientglasgow.co.uk/>

6.2.5 Recommendations for the city of Glasgow

A diagnosis of the current situation of the city of Glasgow was carried out using the compiled data and it was possible to verify that Glasgow City Council had already implemented the sequence of policies outlined in the *unrecognized*, *initial*, and *formalized* stages. Furthermore, it was possible to verify that the policies that Glasgow City Council is currently implementing are in the *supportive* stage of the stakeholder-collaboration maturity model. Based on the sequence of policies defined in the stakeholder-collaboration maturity model, it was possible to make a set of recommendations to improve stakeholder collaboration in the city of Glasgow. These recommendations were communicated to representatives from the City Council.

As an improvement area, collaboration agreements between the media and the City Council should be established (policy 4.2). Currently, Glasgow City Council shares information with local media channels such as newspaper and radio on potential risks and protection measures. This helps the City Council to disseminate information and reach a great number of stakeholders. However, the media does not have a defined role with regards to the dissemination of Glasgow resilience strategy and the resilience-building process. The establishment of collaboration agreements with the media will contribute to promoting the resilience actions that are been carried out at the city level and the opportunities for the stakeholders to participate in the resilience-building process. Furthermore, the media could help to disseminate lessons learned and best practices and contribute to citizens' understanding of the resilience-building process.

Furthermore, in the city of Glasgow, the implementation of resilience strategy and actions needs to be supported by providing incentives to stakeholders (policy 4.3). Access to grant funding or non-monetary incentives such as awards and recognition programs support citizen's and organization's involvement in the implementation of the resilience actions. For instance, in Australia, the Australian government provides resilient awards to citizens and companies that promote initiatives that support and strengthen community disaster resilience. The awards are sponsored by the Australian Government, in

conjunction with the states and cities (Resilient Melbourne and 100 Resilient Cities, 2016).

Finally, in the city of Glasgow, learning activities aimed at monitoring and reflecting on the progress of the city resilience strategy are limited to stakeholders involved in the resilience committees. In order to improve learning on the resilience-building process, representatives from citizens, businesses and companies should be involved in multi-stakeholder committees to evaluate, improve, and decide the progress of the city resilience-building process (policy 4.4). For instance, in the city of Rotterdam, a jury of citizens has been established to receive feedback of the resilience actions implemented in the municipal districts and to promote citizen involvement in planning and running these activities (Gemeente Rotterdam and Resilient Cities, 2015).

6.3 Case study in the city of Donostia/ San Sebastián

Donostia/ San Sebastián is a coastal and riverside city located in the Basque Country (Spain) exposed to natural disasters such as flooding and severe storms. The city has already plans in place against flooding and coastal vulnerabilities (Municipal Disaster Management Plan). Intense and persistent rainfalls, which cause periodic flooding in the city, as well as temporary ones, are the main high risks identified in the Municipal Disaster Management Plan. Following, the evidence of the policies implemented in the city of Donostia/ San Sebastián are described.

6.3.1 Unrecognized

The Donostia/ San Sebastián City Council has a department designated for working on sustainability and climate change adaptation (the Environmental Health and Sustainability department) and another department for working on disaster management (Civil Protection and Security department). The Environmental Health and Sustainability department is in charge of informing, preparing, and planning for the effects of climate change in the long term, while the Civil Protection and Security department collaborates with the municipal

firefighter and police services in the development of the municipal emergency management plans. Table 6.5 describes the evidence of the policies for the *unrecognized* stage.

Table 6.5: Evidence for the *unrecognized* stage.

UNRECOGNIZED STAGE (until 2010)	
AWARENESS	<p>Policy 1.1: Communicate and disseminate potential risks and protection measures.</p> <p>In 1990, the Agency of Meteorology of the Basque Country (Euskalmet) was created and since 2002, it has its own website to provide information to the public on weather forecasts and risk warnings. In addition to the information provided by the Agency of Meteorology, in the Donostia/ San Sebastián City Council there is a press cabinet in charge of providing information on weather forecast and risk warnings. The press cabinet has a detailed contact list of local media channels (such as television, radio or newspapers) to provide them press releases, official information and protection measures in case of disasters. The emergency services such as the firefighter service and police also have website and social media channels such as Facebook and Twitter to inform citizens on disasters.</p>
PREPAREDNESS	<p>Policy 1.2: Develop agreements with the emergency services to identify, plan, and manage disasters.</p> <p>The Emergency Coordination System from the Basque Government is the entity in charge of providing response to all type of disasters (from natural catastrophes to day to day emergencies) within the region since 1981. In case of disaster in the city of Donostia/ San Sebastián, the Emergency Coordination System is in charge of coordinating the municipal and regional emergency services such as the fire service, police service, health care and ambulance services. The main role of the Basque Government Emergency Coordination System is to develop adequate response mechanisms through the establishment of operational tactics and procedures within the region. Its tasks are the coordination of the different stakeholders and services involved in disaster management, the definition of the operational structure to respond to catastrophic events, the management of plans, and the organization and participation in drills.</p> <p>Policy 1.3: Test disaster plans and arrange training exercises.</p> <p>In the city of Donostia/ San Sebastián, the Civil Protection and Security department is in charge of coordinating the disaster exercises that take place at the city. Different stakeholders from the local government and municipal emergency services participate in these exercises such as the firefighter and the police services.</p>

LEARNING

Policy 1.4: Carry out post-disaster evaluation to improve disaster plans.

The Civil Protection and Security department and the municipal fire service organize debriefing meetings to comment on disasters that they have been involved in. At these meetings, the staff from the Civil Protection and Security department, the municipal fire service and police evaluate the actions that worked and did not work. Furthermore, the information and feedback obtained in the meetings is used to review and update disaster management plans and procedures from the municipality.

6.3.2 Initial stage

In 2010, due to a series of flooding events that affected the region, a set of laws were established by the Basque Government Emergency System to improve the existing disaster management system at the regional and local level. In 2010, a new law to regulate the involvement of volunteer organizations in the disaster management system was established. Also, in 2010, a new law that increases the CI's obligations to share information on disaster plans was put into place. Following, Table 6.6 describes the evidence of the policies for the *initial* stage.

Table 6.6: Evidence for the *initial* stage.

INITIAL STAGE (2010 - 2013)	
AWARENESS	<p>Policy 2.1: Organize informative sessions to provide basic preventive measures to citizens and companies in risk-prone areas.</p> <p>In 2010, the city of Donostia/ San Sebastián was exposed to severe flooding issues that caused the river located in the city to burst its banks in the riverside neighborhoods. Since then, citizens that live in the riverside are contacted by the Civil Protection and Security from the City Council to provide them disaster procedures, recommendations and guidelines on how to react to flooding. Furthermore, the Civil Protection and Security department established a database that can be accessed by the different departments of the City Council (i.e. Participation Service and Social Welfare). The database includes telephone contacts of the citizens that live in flooding prone areas in order to provide them warnings and information of the level of the river.</p>

Policy 2.2: Initiate agreements with the CIs to develop and share disaster plans.

In 2010, the Self-protection Act⁷ was established in the Basque Country. The act establishes the obligation of CIs to have a self-protection plan. A self-protection plan includes the assessment of the risks that a company faces and the measures taken by the company to reduce and respond to possible disasters. Furthermore, the Self-protection Act states that companies need to designate a person responsible for the effectiveness of the measures contained in the self-protection plan, as well as verify the relations with the authorities of the emergency services. The different entities from the emergency services (police, firefighter, and health care) have access to the system where the self-protection plans of the companies are stored. The Emergency Coordination System from the Basque Government is the entity in charge of uploading the self-protection plans to the system.

Policy 2.3: Initiate partnerships with volunteer organizations to involve them in disaster management.

In 2010, the Volunteer organizations management Act⁸, which regulates the participation of citizens and volunteer organizations in the Emergency Coordination System, was established in the Basque Country. The Act establishes the requirements that voluntary associations must fulfill with regards to the preparation and response of disasters. Furthermore, the Act recognizes the need to involve volunteer organizations in training and preparation exercises and drills. In the case of the city of Donostia/San Sebastián, the firefighter service is in charge of contacting the volunteers organizations to inform and invite them to participate in drills that are arranged in the CIs located in the city (such as airport, hospitals or energy supply companies).

Policy 2.4: Establish procedures and mechanisms to share lessons learned.

In 2012, the Emergency Management Act⁹ was established by the Basque Government. This Act regulates the coordination in disaster events and learning processes between the Emergency Coordination and Management System, the local administrations (including the city of Donostia/San Sebastián), the emergency services, volunteer organizations, and CIs in the region. Furthermore, the Act establishes procedures for these entities to collaborate in the implementation of civil contingency plans, execution of training exercises, and the promotion and exchange of best practices.

⁷ <https://www.euskadi.eus/bopv2/datos/2010/12/1006090a.pdf>

⁸ <https://www.euskadi.eus/bopv2/datos/2010/02/1000750a.pdf>

⁹ <https://www.euskadi.eus/y22-bopv/es/bopv2/datos/2012/07/1203068a.pdf>

6.3.3 Formalized stage

In 2013, the Civil Protection and Security, Social Welfare and Environmental Health and Sustainability departments started to participate in the Smart Mature Resilience project. This was a first step in bringing together representatives from different departments, who had already carried out resilience activities, to analyze the efforts undertaken in the city to build resilience. However, collaboration at this stage is still incipient. The city lacks a resilience strategy that integrates the resilience-building efforts and the collaboration opportunities among stakeholders (such as academic, educational and scientific entities, citizens and public and private companies). Table 6.7 describes the evidence of the policies for the formalized stage.

Table 6.7: Evidence for the *formalized* stage.

FORMALIZED STAGE (2013 - currently)	
AWARENESS	<p>Policy 3.1: Formalize partnerships with academic, educational and scientific entities to organize resilience awareness programs.</p> <p>With regards to climate change adaptation, the Environmental Health and Sustainability department from the City Council implements actions on climate change adaptation (such as reducing greenhouse gases) since the involvement of the city in the Covenant of Mayors¹⁰ for climate and energy in 2008. Furthermore, the Environmental Health and Sustainability Department has developed a climate change adaptation program to integrate in school centers, business and companies in the sustainability development of the municipality.</p>
	<p>Policy 3.2: Establish working groups to develop a city resilience strategy.</p> <p>In 2016, the Environmental Health and Sustainability department launched a Local Environmental Action Plan¹¹ and established a Climate Change Adaptation Committee to coordinate its development. The Committee met 4 times during 2016 to define the objectives and discuss the content of the Local Environmental Action Plan. The Committee includes representatives from the City Council (i.e. the Environmental Health and Sustainability department, Maintenance and Urban Services and Strategic planning), public companies, social and volunteer organizations and citizens.</p>

¹⁰ http://www.covenantofmayors.eu/about/signatories_en.html?city_id=352

¹¹ [http://www.donostia.eus/info/ciudadano/ma_areas.nsf/voWebContenidosId/E992E362F20D7BE1C1257FF60036FF32/\\$file/adaptacion.pdf](http://www.donostia.eus/info/ciudadano/ma_areas.nsf/voWebContenidosId/E992E362F20D7BE1C1257FF60036FF32/$file/adaptacion.pdf)

	<p>Policy 3.3: Define the roles of the stakeholders to implement the actions defined in the city resilience strategy.</p> <p>Not yet implemented.</p>
LEARNING	<p>Policy 3.4: Formalize multi-stakeholder debriefing meetings and learning process.</p> <p>In 2015, the Crisis Management Committee was established at the City Council. This Committee is formed by representatives from the emergency services such as the police, firefighters, and health service,s different departments of the City Council (Civil Protection and Security, Transport and Mobility, Welfare, Environmental Health and Sustainability department and Press Cabinet), and volunteer organizations (such as the Red Cross). The Civil Protection and Security department is in charge of arranging meetings across the members of the committee prior to and during disasters in order to coordinate the actions across members of the committee. Furthermore, the committee comes together after emergencies and disasters that occur in the city to analyse lessons learned and implement best practices.</p>

6.3.4 Recommendations for the city of Donostia/ San Sebastián

A diagnosis of the current situation of the city was carried out using the compiled data and it was possible to verify that the city of Donostia/ San Sebastián had already implemented the sequence of policies outlined in *unrecognized* and *initial* stages of the stakeholder-collaboration maturity model. Furthermore, it was possible to identify that the city is currently implementing the policies in the *formalized* stage. Taking into account the policies that have already been implemented in this city, the areas in need of improvement and future steps were identified and communicated to the City Council.

A future step that Donostia/ San Sebastián City Council should take, is the development of a city resilience strategy that defines the actions that need to be implemented in the short, medium, and long term to improve the city resilience level. Furthermore, the city resilience strategy needs to define the roles of the stakeholders that need to be involved in the implementation of the resilience actions (policy 3.3). To develop a city resilience strategy, the City Council of Donostia/San Sebastián should designate a person or department responsible of coordinating the resilience-building process and the resilience activities carried out by different departments and stakeholders in the city.

In addition to designating a department responsible for coordinating the resilience-building process, stakeholders from different organizations and backgrounds (such as emergency services, CIs, volunteer organizations, academic, scientific and educational entities) should be provided with the opportunity to participate in the development of the city resilience strategy. In this vein, multi-stakeholder working groups that meet on a regular basis to define the objectives and actions of the city resilience strategy need to be established (policy number 3.2). One recommendation for the city is to broaden the existing working groups that have been established by the Environmental Health and Sustainability department to develop the Local Environmental Action Plan. These groups should cover the resilience-building process from a holistic approach and work on activities aimed at enhancing climate change adaptation, disaster management, and business continuity planning among others. Furthermore, additional stakeholders such as academic, educational, and scientific entities with diverse technical, strategic or academic backgrounds in the field of resilience should be invited to participate in these working groups.

The aforementioned recommendations correspond to the policies that Donostia/ San Sebastián City Council should carry out to fulfil the *formalized* stage of the stakeholder-collaboration maturity model. Once these policies are accomplished, the City Council should work on the implementation of the policies defined in the *supportive* stage of the stakeholder-maturity model. Recommendations for the implementation of the policies in the *supportive* stage can be found in section 6.2.5.

6.4 Differences between the two case studies

The case studies carried out within this research present the evolution of collaboration between the local government and city stakeholders in two cities at different maturity stages. On the one hand, the city of Glasgow is in the *supportive* stage. The progresses made by Glasgow City Council, since 2011, with regards to the resilience-building process has improved the collaboration with a wide variety of city stakeholders to address issues such as flood risk

management, drainage, and effects of climate change. Figure 6.1 presents the evolution of the policies implemented in the city of Glasgow to improve the collaboration with city stakeholders.

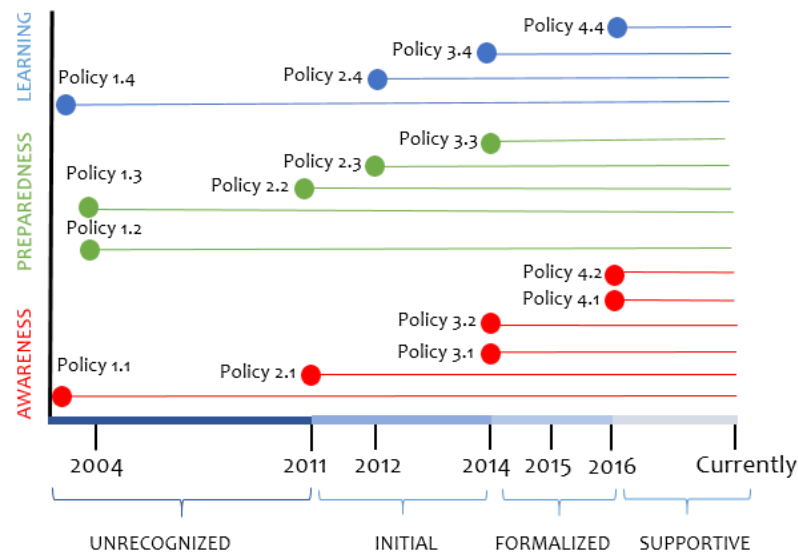


Figure 6.1: Evolution of the policies implemented in Glasgow.

On the other hand, the city of Donostia/San Sebastián is in the supportive stage. In the city of Donostia/San Sebastián, the collaboration between the different departments from the City Council, the emergency services, CIs, and volunteer organizations has improved in the last period of time (since 2010). However, the city has not worked on the interdependencies and integration of the efforts with regards to disaster management and climate change adaptation from a resilience holistic approach. In this vein, the city has yet not reached the *supportive* stage. Figure 6.2 presents the evolution of the policies implemented in the city of Donostia/ San Sebastián to improve the collaboration with city stakeholders.

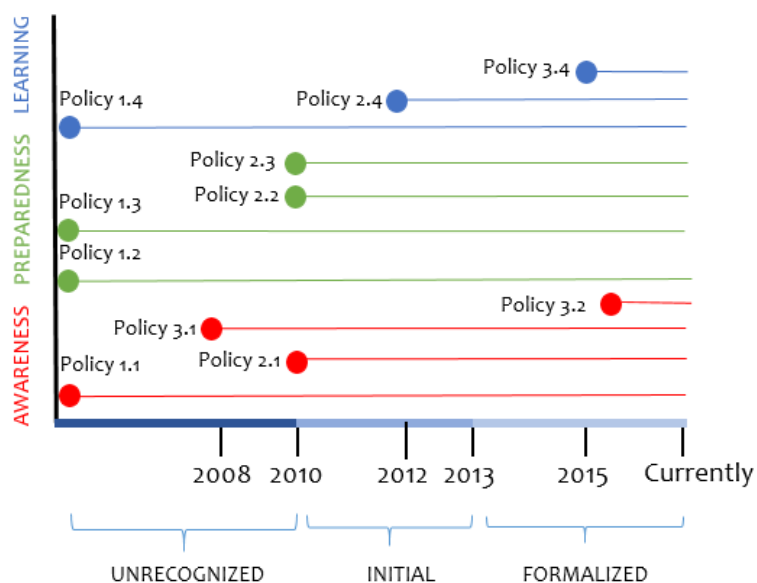


Figure 6.2: Evolution of the policies implemented in Donostia/San Sebastián.

Based on the evidence gathered in the case studies, it has been possible to conclude that the progress in stakeholder collaboration has been greater in the city of Glasgow. Glasgow City Council has been able within a period of time of two years (from 2014 to 2016) to develop a city resilience strategy, establish multi-stakeholder committees for evaluating the resilience-building process and a resilient team to coordinate resilience-building actions. In this vein, it has been possible to identify a set of possible reasons for its success. First, the city has been actively involved in international networks and projects with other cities in which it has received resources and funding to specifically build city resilience (such as the 100 Resilient Cities programme and the Smart Mature Resilience project).

Furthermore, through these networks, the city of Glasgow has been able to obtain successful methodologies, guidelines, best practices and lessons from other cities. Moreover, Glasgow City Council has committed to becoming a pioneering city in the field of resilience and it has enhanced the governmental arrangements and invested the required resources to promote the resilience-

building process (such establishing a Chief Resilience Officer, a resilience team and multi-stakeholder committees as well as develop a city resilience strategy).

Despite the differences between the two cities, in both case studies it has been possible to verify the influence of the regional and national government in the implementation of policies at the city level. Although the policies included in the stakeholder-collaboration maturity model aim to be implemented by the local governments, it has been possible to verify that in both cities there is a number of policies that have been implemented at the regional and national level. As consequence of the policies implemented at the regional and national levels, partnerships between the local government and city stakeholders have been established at the city level. For instance, the establishment of regulations at the regional and national levels have enhanced the collaboration between the City Council, volunteer organizations and CIs in the cities of Glasgow and Donostia/San Sebastián.

6.5 Challenges and recommendations

During the case studies carried out within this research it was possible to identify a series of challenges that local governments encounter to collaborate with different city stakeholders in the resilience-building process. Following the identified challenges are described. In addition to the challenges, the recommendations provided in the stakeholder-collaboration maturity model to overcome the challenges are described.

One of the challenges encountered in the cities under study is that stakeholders from different organizations with diverse technical, strategic or academic backgrounds tended to interpret the concept of resilience differently. For some stakeholders, such as representatives of the emergency services or civil protection offices, the concept of resilience entails the preparation, response, and recovery from risks that occur in the short term (up to five years). However, there were other stakeholders (i.e. research and scientific entities) who were more concerned about the need to adapt to disasters which require a long-term approach and whose results may take years to see such as climate change effects. In this vein, the stakeholder-collaboration maturity model suggests opening

dialogue, building mutual understanding, and setting common objectives for the resilience-building process. In order to collect different stakeholder's perceptions and requirements, the stakeholder-collaboration maturity model proposes carrying out public consultations with city stakeholders to receive feedback on the resilience strategy and the actions that need to be implemented to improve the city resilience level (policy 5.1).

Another challenge associated with the resilience-building process is the difficulty of involving citizens in the resilience-building process. With regards to this, the stakeholder-collaboration maturity model suggests to provide citizens with opportunities to train and build capacity for improving coordination in case of disasters (policy 5.2) for example by including education programs about disaster in the school curriculum. Furthermore, a main concern, which was raised during the interviews carried out within the case studies, was the difficulty of engaging the private sector, especially small businesses and companies. With regards to this challenge, the stakeholder-collaboration maturity model outlines the need to promote resilience certification at CIs and public and private companies to comply with the implementation of resilience measures (policy 5.3).

Finally, in order to promote resilience awareness in the day-to-day activities, the stakeholder-collaboration maturity model suggests the local government to set up participatory mechanisms where citizens have the opportunity to share expertise and best practices and promote the benefits of the resilience-building process (policy 5.4). For instance, Bristol City Council has established a platform with private sponsors and local universities for connecting people, organizations, ideas and knowledge across the city. This platform enables ideas to be connected across themes such as climate preparedness and disaster management and it also connects project ideas with possible funders (Bristol City Council and 100 Resilient Cities, 2017).

6.6 Conclusions

The implementation of the stakeholder-collaboration maturity model consists of assessing the current maturity stage of a city by gathering evidence of the policies that have already been implemented in the city. In order to gather evidence of the policies implemented during the case studies carried out in the cities of Glasgow and Donostia/ San Sebastián, an implementation questionnaire was used. This questionnaire was approached with a variety of city stakeholders such as representatives from the emergency services, different departments from the City Council, private and public companies, volunteer organizations and universities.

As result of the case studies, it was possible to prove the usefulness of the stakeholder-collaboration maturity model for improving progressively the collaboration between the local government and city stakeholders. On the one hand, it was possible to assess the current maturity stage of the cities under study and detect improvement areas and recommendations. On the other hand, a set of challenges associated to the collaboration of stakeholders in the city resilience-building process were also identified. Based on these challenges, this research presents a set of recommendations for the local governments to overcome them.

Finally, with regards to the implementation of the stakeholder-maturity model, it was possible to verify during the case studies, that the success and the time that each city needs to fulfil the policies at each maturity stage is different. This is due to a variety of factors such as local, regional and national regulation and legislation, the commitment from the local government, and the resources allocated to the resilience-building process.

Conclusions, Limitations and Future Research

This chapter makes a summary of the results and the conclusions reached in this research. Furthermore, it presents the main limitations of the stakeholder-collaboration maturity model. Finally, it presents future research lines to address existing limitations and improve the stakeholder-collaboration maturity model.

7.1 Conclusions

Building resilient cities requires the collaboration of a wide variety of city stakeholders including the local government, emergency services, citizens, volunteer organizations, and public and private companies. However, not all stakeholder groups have the same responsibilities with regards to the resilience-building process. From all levels of governments, local governments play a key role in contributing to making cities resilient. Being the closest governmental body to the citizens, local governments are in a more privileged and advantageous position to contribute to making cities resilient to disasters.

As a result of the literature review carried out on city resilience, it was possible to identify the gaps of existing frameworks for building city resilience. Frameworks that help local governments to engage with different stakeholders in the resilience-building process remain undeveloped. Furthermore, there is little understanding about the roles and responsibilities of the different city stakeholders with regards to the resilience-building process. Based on the evolution of stakeholder collaboration between the local government and city stakeholders in cities working towards improving their resilience level, this research presents the development of a stakeholder-collaboration maturity model.

7.1.1 Resilience principles

Based on a literature review that was carried out on the concept of city resilience, this research proposes a set of resilience principles (*collaboration, awareness, preparedness, and learning*) that improve through the collaboration of city stakeholders. Furthermore, this research has analyzed the contribution of *collaboration* principle to the improvement of *awareness, preparedness, and learning* principles. Based on this contribution, the stakeholder-collaboration maturity model was developed.

7.1.2 Research methodology

The stakeholder-collaboration maturity model was developed as a result of an iterative process that included semi-structured interviews with representatives from six different cities committed to improving their level of city resilience. Furthermore, two case studies were carried out in two cities in order to implement the stakeholder-collaboration maturity model. These case studies aimed at gathering evidence of the evolution of the collaboration between the local government and city stakeholders to validate the sequence of stages and policies presented in the maturity model. Through the case studies it was possible to assess the current maturity stages of the cities under study, and make a series of recommendations for the local governments in these cities to implement.

7.1.3 Stakeholder-collaboration maturity model

The stakeholder-collaboration maturity model represents the evolution of the collaboration between the local government and city stakeholders in the resilience-building process through a sequence of five maturity stages. In each stage, the stakeholder-collaboration maturity model provides policies and indicators for the local government to improve progressively the collaboration with the different stakeholders. Furthermore, the stakeholders that need to be involved in the implementation of each policy are identified.

The stakeholder-collaboration maturity model does not assume that all stakeholder groups share the same concerns in each city but provides a mean for different stakeholders to come together and collaborate with the local government in the city resilience-building process. In this vein, the stakeholder-collaboration maturity model can be used for several purposes:

- It can be used by the stakeholders of a city to come together to work towards the resilience-building process.
- It can be used as a reference model for the local governments to decide the most effective steps to collaborate with the different city

stakeholders. In this vein, the stakeholder-collaboration maturity model can help local governments to detect points that need to be improved and provides guidance about the sequential order of policies that should be implemented.

- It can be used by cities to identify the challenges associated with the involvement of stakeholders in the resilience-building process as well as recommendations to overcome the challenges.

7.2 Research limitations

The stakeholder-collaboration maturity model developed in this research is limited in various ways. Following, the main limitations of this research are presented:

- Though all levels of governments are generally involved in the resilience-building process, the literature on city resilience emphasize the critical role of the local governments in making cities resilient. In this vein, the stakeholder-collaboration maturity model does not take into account the influence of stakeholders out of the city (such as regional and national governments) in the resilience-building process. During the case studies it has been possible to verify that there are a number of policies that have been implemented at regional and national level that affect the collaboration between city stakeholders.
- The maturity stages, policies and indicators included in the stakeholder-collaboration maturity model are defined from a strategic approach. Therefore, in order to implement the stakeholder-collaboration maturity model in practice, it is necessary to consider the specific characteristics of each individual city.
- The stakeholder-collaboration maturity model provides a set of indicators to assess the implementation of the policies. Although the usefulness of the indicators has been validated by representatives from

different cities, currently, the use of indicators for assessing the city resilience is limited. The reason for this is that the monitoring and evaluation of the progress of the resilience-building process is still undeveloped in cities.

- The resources and the time required by the local government to go from one stage to another need to be further explored and quantified. Information on the quantity of resources and the time required by the local government to implement the policies would be helpful to evaluate the return of investment of fulfilling the policies provided in the stakeholder-collaboration maturity model.
- The most advanced stage of the stakeholder-collaboration maturity model (*proactive* stage) has not been implemented during the case studies and therefore, the policies defined in this maturity stage have not been verified with evidence.

7.3 Future steps

Based on the limitations of this research, the future main research steps that need to be undertaken to improve the stakeholder-collaboration maturity model and its implementation are presented:

- Collaboration between the city stakeholders can be influenced by the commitment of local, regional, and national governments to the resilience-building resilience. Furthermore, the involvement of a city in networks with other cities also influences the development of collaboration partnerships between city stakeholders. This research however, is limited with regards to analyzing the influence of the commitment of the local, regional and national government to the improvement of stakeholders' collaboration. Therefore, further research is required to evaluate the influence of the different levels of government and the involvement of the city in networks of cities

to the fulfilment of the policies provided in the stakeholder-collaboration maturity model.

- Based on a literature review, this research proposes a set of resilience principles (*collaboration, awareness, preparedness and learning*) that improve through stakeholder collaboration in the city resilience-building process. This research has analyzed the contribution of *collaboration* principle to the improvement of *awareness, preparedness* and *learning* principles. Nevertheless, the interrelations among the resilience principles need to be further explored.
- The indicators defined in this research to assess the implementation of the policies included in the stakeholder-collaboration maturity model lack to provide qualitative information. Therefore, indicators that provide qualitative progress on the collaboration of stakeholders need to be further defined.

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Appendix A: First Questionnaire of the Delphi

This appendix presents the questionnaire that was sent in the first round of the Delphi study. The questionnaire presents a set of statements that aim at validating the influence of collaboration through Virtual Communities of Practice (VCoPs) to the improvement of resilience. The statements are classified into the following six principles of organizational resilience: top management commitment, staff engagement, training and preparedness, situation awareness, flexibility, and networking. These resilience principles were the preliminary principles defined in this research and are included in the definitive resilience principles defined in this research (collaboration, awareness, preparedness and learning).

VCoPs and Resilience

A Virtual Community of Practice (VCoP) is defined as a group of people who share a common concern, a set of problems, or interest in a topic and who come together to fulfill both individual and group goals. VCoPs focus on sharing best practices and creating new knowledge to advance a domain of professional practice. Interaction on an ongoing basis is an important part of this. In the crisis management field, the inter-organizational collaboration is increasingly important to deal successfully with emergency situations so in this context, VCoPs provide a new model for connecting people with the spirit of learning, knowledge sharing, and collaboration.

The aim of this survey is to analyze if the existence of VCoPs in crisis management field can help to improve the level of organizational resilience.

Organizational resilience is defined as capacity of the system to make decisions and take actions that lead to reduce the probability of failure, to reduce the consequences from failure and to reduce the time needed to carry out all the response and recovery activities.

The survey is divided into two sections. The first one contains general questions about yourself, the second section analyzes the relationship between VCoPs and organizational resilience principles.

Once we receive the questionnaires from all participants we will send you a document with the results of this research.

We would appreciate if you could answer to the questionnaire before July 10th. The estimated time to fulfill the questionnaire is 10 minutes.

* Required

SECTION I: General questions

What's your name? *

1. Which of these levels best describes your position within your organization? *

- Top management
- Middle management
- Supervisor/team leader
- Staff
- Other:

2. Which of the following best describes the department or business unit you work in? *

- Academic/Researcher
- Administration
- Civil protection
- Emergency Planning/Management
- First responder
- Health & Safety
- Risk management
- Volunteer
- Other:

3. What is your job title? ***4. How long have you worked in your field? ***

- < 1 year
- 1-3 years
- 4-10 years
- 11-20 years
- 21+ years

SECTION II: Organizational resilience principles

Following we present the principles that define the organizational resilience and we would like you to answer to what extent you agree with each statement.

In order to answer the questions included in this section, you should have in mind that the concept of a VCoP refers to a group of main stakeholders from different organizations, regions and countries involved in crisis management such as first responders, civil protection, and government organizations among others. The diversity of cultures and ways of working of the members of the VCoP contributes to the enrichment of the information and knowledge shared in this VCoP.

Top management commitment

Top managers should be committed to resilience in both day-to-day and crisis situation and they should promote a resilience based culture within the organization, providing the required resources for this aim. Managers should foster a transparent environment with collective identity by trusting in operators and empowering them.

5. To what extent do you agree or disagree with the following statements? *

	Strongly agree	Agree	Disagree	Strongly Disagree	Don't know
A VCoP where experiences and training activities developed are shared, helps committing the top management and assigning resources for improving training.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A VCoP where experiences and problems occurred are shared, helps committing the top management and assigning resources for the resolution of problems.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Staff engagement

Staff engagement refers to the involvement of the staff with the resilience building process since they are responsible, accountable, and occupied with it. This engagement lies in the understanding of the link between their own work, the organization's resilience, and its long term success.

6. To what extent do you agree or disagree with the following statements? *

	Strongly agree	Agree	Disagree	Strongly Disagree	Don't know
A VCoP where members of different organizations share information about incidents and lessons learned promotes proactive postures among the staff to share information with other organizations.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A VCoP among organizations improves trust and teamwork among the staff of different organizations.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A VCoP encourages the staff to be actively concerned with developing skills and knowledge required for resilience development.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Training and Preparedness

Workers at the company should have preparedness and training activities that serve to enhance and maintain operator's knowledge of the complex operations, to improve their technical competence, to enable them to recognize hazards and to respond to 'unexpected' problems appropriately.

7. To what extent do you agree or disagree with the following statements? *

	Strongly agree	Agree	Disagree	Strongly Disagree	Don't know
Sharing training materials/documents across organizations through a VCoP helps improving staff training.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sharing mistakes, solutions, and lessons learned through a VCoP improves staff or organizations' learning.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sharing mistakes, solutions, and lessons learned through a VCoP helps the staff to learn from others' failures and best practices.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Having a VCoP to share information facilitates the availability of emergency procedures, regulations, and legislations across organizations.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sharing the good reputation of already developed courses through a VCoP may lead to repeat them in other organizations.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Situation Awareness

Awareness is the understanding of what is happening around (both internal to the organization and externally) and understanding of what that information means for the organization's present and future. It refers to the ability to see the big picture of companies (rather than simplifying) complex system feedbacks. Failures can occur anywhere at any time, and that is why an attentive attitude is vital.

8. To what extent do you agree or disagree with the following statements? *

	Strongly agree	Agree	Disagree	Strongly Disagree	Don't know
Sharing near misses and mistakes that occurred across organizations through a VCoP helps the organization to be more aware of its vulnerability level against potential crises.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sharing information about near misses and mistakes occurred in organizations through a VCoP leads to improve the existing emergency procedures.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The information shared in a VCoP can help to understand better the complex relationships among organizations.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Flexibility

Organizations and workers at the organization should have enough flexibility and adaptive capacity to alter its strategies, structures, and procedures to withstand perturbations.

9. To what extent do you agree or disagree with the following statements? *

	Strongly agree	Agree	Disagree	Strongly Disagree	Don't know
Sharing in the VCoP already implemented innovations to deal with problems may lead to improve the creativeness among the staff of different organizations.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The shared repertoire of information of a VCoP facilitates to obtain expert assistance when something unexpected comes up.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Networking

Creating a network of relevant stakeholders involved in crisis management (Critical Infrastructure operators, regulators, government, civil protection, first responders, etc.), where they can trust each other to share different experiences and lessons learned, may help them to improve their crisis management knowledge and the number of collaboration agreements to enhance future crisis prevention and resolution.

10. To what extent do you agree or disagree with the following statements? *

	Strongly agree	Agree	Disagree	Strongly Disagree	Don't know
A VCoP helps to contact potential new partners.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A VCoP containing updated short biographies of its members and information regarding staff capabilities of different organizations enables to find the person or organization with more expertise and experience to handle a problem.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A VCoP helps to learn from events occurred and lessons learned reported in other organizations.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A VCoP with members from different external organizations helps having unified procedures and emergency plans within organizations and interdependent stakeholders.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A VCoP leads people of different organizations who might collaborate together to have a unified purpose in the management of future events.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A VCoP improves coordination among organizations and stakeholders.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A VCoP helps to get assistance from community members from external organizations when something comes up and we don't have enough capacity to handle it.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Appendix B: Second Questionnaire of the Delphi

This appendix presents the questionnaire that was sent in the second round of the Delphi study. The questionnaire presents a set of statements that aim at validating the influence of collaboration through Virtual Communities of Practice (VCoPs) to the improvement of resilience. The statements are classified into the following six principles of organizational resilience: top management commitment, staff engagement, training and preparedness, situation awareness, flexibility, and networking. These resilience principles were the preliminary principles defined in this research and are included in the definitive resilience principles defined in this research (collaboration, awareness, preparedness and learning).

VCoPs and Organizational Resilience

A Virtual Community of Practice (VCoP) is defined as a group of people who share a common concern, a set of problems, or interest in a topic and who come together to fulfill both individual and group goals. VCoPs focus on sharing best practices and creating new knowledge to advance a domain of professional practice. In the crisis management field, the inter-organizational collaboration is increasingly important to deal successfully with emergency situations so in this context, VCoPs provide a new model for connecting people with the spirit of learning, knowledge sharing, and collaboration.

The aim of this survey is to analyze if VCoPs in crisis management field can help to improve the level of organizational resilience. Organizational resilience is defined as capacity of the system to make decisions and take actions that lead to reduce the probability of failure, to reduce the consequences from failure and to reduce the time needed to carry out all the response and recovery activities.

Answers to the questionnaire will keep confidential so there will not be any personal information or any relation between experts and particular answers. Once we receive the questionnaires from all participants we will send you a document with the results of this research.

We would appreciate if you could answer to the questionnaire. The estimated time to fulfill the questionnaire is 10 minutes.

The survey is divided into three sections. The first one contains general questions about yourself, the second section analyzes the relationship between VCoPs and organizational resilience principles and finally, several questions about limitations of the VCoPs are included in the survey.

* Required

Please, write your name in the following text box: *

Which organization/company do you belong to? *

SECTION I: General questions

Which of the following best describes the department or business unit you work in? *

- Academic/Researcher
- Critical Infrastructures
- Civil protection
- Emergency Planning/Management
- First responder
- Other:

Appendix C: First Round of Interviews

This appendix presents the questionnaire that was used during the first round of semi-structured interviews carried out with city representatives.

PRESENTATION OF THE QUESTIONNAIRE

This questionnaire is part of a research thesis that focuses on analyzing how the development of **collaborative networks** between the agents of a city in emergency management can help to improve **the city's resilience level**. The objective of the questionnaire is to identify how the collaboration between the agents of a city in emergency management has evolved in the last 10 years in different European cities.

Following we present **20 questions** that we would like you to complete regarding how the **agents of your city** collaborate in emergency management and how these collaborations have evolved **in the last 10 years**.

We really appreciate your help and we will be happy to provide you the results of this analysis.

Thank you very much!

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INTRODUCTION

Current research recognizes the need to engage multiple agents of a city such as local government, civil protection and emergency management organizations, public and private sector, and citizens in order to successfully manage disasters and thus improve the resilience level of a city (da Silva et al. 2012, Molin Valdés et al. 2013). A **resilient city** can be defined as a city that is able to withstand shocks and chronic stresses and to avoid their impact (**mitigation and preparation**), to deal with the impact of the shocks (**response**), and to recover in ways that reduce future risks (**recovery**) (Malalgoda et al. 2014; Oteng-Ababio et al. 2015). In this regard, the involvement and collaboration between the different agents of a city during the emergency management phases (**mitigation and preparation, response, and recovery phases**) are of utmost importance to improve the resilience level of a city (Kapucu et al. 2010; Oktari et al. 2015; Weichselgartner, 2014).

Based on a literature review on city's resilience, this research has identified a set of principles (**collaboration, learning, training and preparedness, and awareness**) that can potentially improve the overall resilience of a city towards emergencies. Furthermore, this research recognizes that the development of collaborative networks between the agents of a city during the emergency management phases contributes to improve the overall resilience of the city. Collaborative networks are defined as relationships and partnership arrangements among several agents, representing different sectors and levels that collaborate and share information to achieve common goals and benefits (Jung, Song 2014; Kapucu 2012).

This research will analyze how the development of collaborative networks between the city's agents contributes to the accomplishment of the resilience principles and thus, to the improvement of the overall resilience of the city.

QUESTIONNAIRE DATA

Name of the city:	
Name of the respondent:	
Professional role:	
Years of experience:	
Email of the respondent:	

AGENTS OF A CITY

Figure 1 presents the agents of a city that need to be involved in emergency management collaborative networks for improving the resilience level of the city.

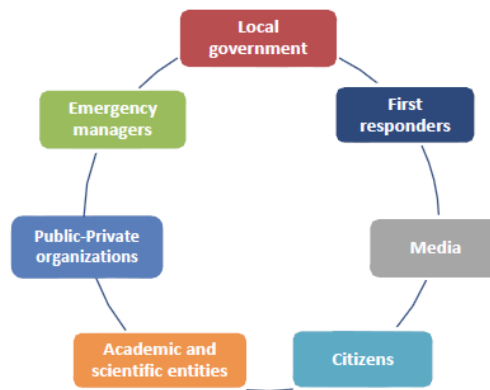


Figure 1: Agents of the city.

Q1: Following the roles of the city agents are presented. Please explain the **ROLES** of these **AGENTS** in your city.

- **Emergency managers** are agencies or groups that are involved in all the phases of emergency management. Some of their functions include developing emergency plans to minimize the effects of emergencies, warn and educate agents of the city about emergencies.

ROLES OF THE AGENT IN YOUR CITY

- **Local government** plays a crucial role in managing emergencies, attending the needs of the agents of the city and delivering services such as health, education and transport to the city.

ROLES OF THE AGENT IN YOUR CITY

- **First responders** include firefighters, health and police services whose role is essential in all phase of emergencies. First responders are vital in the response of emergencies as they are the ones who first arrive and assist emergencies.

ROLES OF THE AGENT IN YOUR CITY

- **Media** is in charge of disseminating information about emergencies and hazards that will affect the city. Furthermore, it contributes to raising awareness and understanding how to manage emergencies among the agents of the city.

ROLES OF THE AGENT IN YOUR CITY

- **Citizens** include voluntaries and community-based organization which contribute to and support public awareness, a culture of prevention and education on emergency management.

ROLES OF THE AGENT IN YOUR CITY

- **Academic and scientific entities** such as universities and research centers contribute to increasing the knowledge on how to better mitigate and prepare for, respond to, and recover from emergencies.

ROLES OF THE AGENT IN YOUR CITY

- **Public-private companies** include critical infrastructures which deliver essential needs to the city such as health care, transportation systems, telecommunications, etc. It also refers to companies such as consultancies, insurance companies, etc. that engage in awareness-raising and training programs, develop technologies, and share and disseminate knowledge to better manage emergencies.

ROLES OF THE AGENT IN YOUR CITY

Q2: Please explain if there is an **AGENT (OR AGENTS) MISSING** in Figure 1 and its **ROLES**.

AGENT MISSING	ROLES OF THE AGENT

PRINCIPLE 1: COLLABORATION

Q3: Please explain **WHICH AGENT** collaborate **WITH WHICH AGENT** during which **PHASES OF EMERGENCY MANAGEMENT** (mitigation and preparation, response, or recovery). Please explain **THE REASON** for these agents to collaborate.

AGENT	COLLABORATES WITH which AGENT	REASON for these agents TO COLLABORATE	EMERGENCY PHASE in which the agents collaborate
			<input type="checkbox"/> Mitigation and preparation <input type="checkbox"/> Response <input type="checkbox"/> Recovery
			<input type="checkbox"/> Mitigation and preparation <input type="checkbox"/> Response <input type="checkbox"/> Recovery
			<input type="checkbox"/> Mitigation and preparation <input type="checkbox"/> Response <input type="checkbox"/> Recovery
			<input type="checkbox"/> Mitigation and preparation <input type="checkbox"/> Response <input type="checkbox"/> Recovery

Q4: Please indicate which **AGENTS** that did not collaborate before **HAVE STARTED TO COLLABORATE** during the last 10 years. Please indicate **WHEN** they started to collaborate and **THE REASON** for these agents to collaborate.

AGENTS	WHEN	REASON to start to collaborate

Q5: Please describe which **MILESTONES** (for example specific emergencies, laws, regulations or initiatives) have **CHANGED HOW AGENTS COLLABORATED** in the last 10 years.

MILESTONES	AGENTS involved in the change	HOW THE COLLABORATION HAS CHANGED

Q6: Please indicate the **EXISTING COLLABORATIVE PLATFORMS** for the agents of the city to collaborate and exchange information regarding emergency management.

TYPE AND FUNCTION of the platform	AGENTS that can access the platform	TYPE OF INFORMATION shared in the platform	EMERGENCY PHASE in which the platform is used
			<input type="checkbox"/> Mitigation and preparation <input type="checkbox"/> Response <input type="checkbox"/> Recovery
			<input type="checkbox"/> Mitigation and preparation <input type="checkbox"/> Response <input type="checkbox"/> Recovery
			<input type="checkbox"/> Mitigation and preparation <input type="checkbox"/> Response <input type="checkbox"/> Recovery

Q7: Please indicate **THREE DIFFICULTIES** for the improvement the city's agents **COLLABORATION**.

DIFFICULTIES

Q8: Please indicate which **AGENT** at the city level **COORDINATES** other agents who are involved in emergency management. Please explain **HOW** the agent **COORDINATES** other agents.

AGENT (COORDINATOR)	AGENTS who are COORDINATED by the coordinator	HOW the AGENT COORDINATES the other agents

Q9: Please indicate **THREE DIFFICULTIES** for the improvement the city’s agents **COORDINATION**.

DIFFICULTIES

PRINCIPLE 2: LEARNING

Q10: Please indicate the **AGENTS** who come together and evaluate the actions carried out in managing emergencies. Please indicate **HOW OFTEN** these agents come together and the **TYPE OF INFORMATION** they share.

AGENTS	HOW OFTEN they come together	TYPE OF INFORMATION they share

Q11: Please indicate the **AGENTS** who share lessons learned and best practices **BETWEEN THEM**. Please specify what **KIND OF INFORMATION** these agents share.

AGENTS	KIND OF INFORMATION they share

Q12: Please indicate **THREE DIFFICULTIES** for the improvement the city’s agents **LEARNING**.

DIFFICULTIES

PRINCIPLE 3: TRAINING AND PREPAREDNESS

Q13: Please indicate which **AGENTS** participate with other agents in training exercises or emergency drills. Please specify **SINCE WHEN** these agents train together and **HOW OFTEN** they carry out training exercises or emergency drills.

AGENTS	SINCE WHEN	HOW OFTEN

Q14: Please indicate **THREE DIFFICULTIES** for the improvement the city's agents **TRAINING AND PREPAREDNESS**.

DIFFICULTIES

PRINCIPLE 4: AWARENESS

Q15: Please indicate the **AGENTS** who carry out **ACTIONS** in order to increase other's **AGENT'S AWARENESS**.

AGENTS	ACTIONS	WHICH AGENT'S AWARENESS

Q16: Please indicate to what extent **AGENTS ARE AWARE** of the necessity to collaborate with other agents of the city for better managing emergencies.

AGENTS	Extremely aware	Very aware	Moderately aware	Slightly aware	Not at all aware
First responders	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Emergency managers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Local government	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Citizens	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Media	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Public-Private organizations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Academic and scientific entities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q17: Please indicate **THREE DIFFICULTIES** for the improvement the city's agents **AWARENESS**.

DIFFICULTIES

RESILIENCE

Q18: Please indicate to what extent the **RESILIENCE OF THE CITY** improved thanks to the collaboration between the agents of the city.

To a very large extent	To a large extent	To a moderate extent	To a small extent	To a very small extent
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Comments:

--

Q19: Please indicate the **EVIDENCE** for the improvement of the city resilience **in the last 10 years**.

EVIDENCE

Q20: Please indicate the **DIFFICULTIES** for improving the **CITY RESILIENCE**.

DIFFICULTIES

Please specify any **SOURCES** where we can obtain more information regarding the evolution of emergency management between the agents of your city in the last 10 years (**internet sources, contact persons, available documents...**).

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Appendix D: Second Round of Interviews

This appendix presents the questionnaire that was used in the second round of semi-structured interviews carried out with city representatives. Furthermore, the results obtained are presented.

QUESTIONNAIRE

A Maturity Model for Integrating Resilience in the City Planning



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PRESENTATION OF THE QUESTIONNAIRE

This questionnaire is part of a research thesis that aims at developing a **maturity model for integrating resilience in the planning of cities**. Maturity models describe the evolution of the characteristics of a process from an initial stage to a most advanced stage through a number of intermediate stages. **The hypothesis of this research is that the integration of resilience in European cities follows similar stages**. Furthermore, the research considers that to build city resilience it is necessary to involve the government, community, public, private, and academic sectors.

We would like you to help us identifying the maturity stages that a city follows to integrate resilience in the city planning and involve the agents of the city in the resilience building process.

We please ask you to complete the following **5** questions. The information of your answers will kept confidential.

Thank you very much for your time and effort!

RESPONDER DATA

Name of the city:	
Name of the respondent:	
Professional role:	
Years of experience:	
Email of the respondent:	

RESILIENCE DEFINITION

The disaster resilience of a city is determined by the degree to which individuals, communities, institutions and public and private organizations within the city are capable of preparing and responding to disasters, learning from past disasters and reducing the risk of future ones (UNISDR 2005, 100 RESILIENT CITIES 2015).

Within a city there are different stakeholders, entities, and organizations that can contribute to the resilience building process. The agents of the city can be classified into the following groups:

- **Emergency service** (i.e. police, health care, fire brigade, civil protection, emergency managers, first responders ...).
- **City government** (i.e. city council, local and regional and national government).
- **Citizens** (i.e. neighborhoods, community based organizations, voluntary groups...).
- **Public and private companies** (i.e. business, insurance companies, consultancies...).
- **Critical infrastructures** (i.e. energy, water, health care, transportation systems, food...)
- **Academic and scientific entities** (i.e. universities, schools, research centers...).

DESCRIPTION OF THE MATURITY STAGES

To develop the maturity model we have identified some similar maturity stages that European city get across to build city resilience. Following, we describe the different maturity stages that have been identified.

The maturity stages are shown in ALPHABETICAL order:

- **Formalized:** A resilience unit (department or officer) is created to build city resilience and a strategy plan, and objectives for improving the city resilience are defined. The resilience unit works with the government, emergency service, and critical infrastructures of the city to improve the resilience of the services provided in the city (e.g. waste management, water supply...).
- **Initial:** Initial initiatives/projects/arrangements between the government, emergency service and academic entities of the city take place to work on the development of the city resilience (e.g. participation in 100 Resilient Cities programme, Smart Mature resilience project...).
- **Proactive:** All sectors the city (public, private, government, academic and scientific, community) feel responsible for building city resilience and are part of multi-sector collaborative networks in which they share relevant knowledge and participate in activities to build city resilience.
- **Supportive:** The city government supports economically the development of resilience plans for communities, business, and neighborhoods. Thus, citizens and public and private companies are provided with grants and funding to build resilience.
- **Unrecognized:** Building city resilience is not integrated in the city planning. The city government works on managing risks and responding to disaster but does not have a plan or strategy for building city resilience with the involvement of the agents of the city.

Q1: Do you think there are any maturity stages missing? If yes, please explain it.

Added Stage A:	
Added Stage B:	
Added Stage C:	

Comments:

Q2: Put the maturity stages in the temporal order in which they occur in a city:

- "1st stage" means that the maturity stage is the first to appear in temporal order.
- If you have added stages (A, B, or C) you would need to complete 6th, 7th or 8th stages.
- If you think some maturity stages are parallel you can put them in the same stage.

Maturity stages								
	1st stage	2nd stage	3rd stage	4th stage	5th stage	6th stage	7th stage	8th stage
Formalized								
Initial								
Proactive								
Supportive								
Unrecognized								
Added Stage A:								
Added Stage B:								
Added Stage C:								

DESCRIPTION OF THE POLICIES

Following we present a series of policies that need to be implemented to improve the city resilience.

- **Establish agreements with critical infrastructures:** Agreements with critical infrastructures of the city to ensure essential services in case of emergencies are established.
- **Organize awareness activities:** The city government integrates citizens in the resilience building process. Programs and activities are organized to foster citizens' awareness on the necessity to collaborate with the emergency service for effectively dealing disasters.
- **Provide opportunity to become volunteer:** Citizens can apply to be volunteers and collaborate with the emergency service to better prepare, respond, and recover from disasters.
- **Establish cooperation agreements with community organizations:** Community based organizations (e.g. Grass roots organizations, youth organizations, churches, day centers...) from the different neighborhoods of the city cooperate with the city government to contribute to develop disaster resilience plans, foster awareness among citizens...
- **Designate an emergency coordinator:** There is a designated emergency operation center/entity in charge of integrating and coordinating all emergency service entities (e.g. police, firefighters, health service...) responsible for managing risks and responding to disasters.
- **Support resilience collaborative networks:** Resilience collaborative networks that involve different agents of the city (citizens, emergency service, public and private companies, academic and scientific entities) are supported by the city government. Resilience collaborative networks share relevant information and work together on the development of the city resilience.
- **Require resilience plans:** The city governments requires citizens, public and private companies to develop community, household or business resilience plans.

- **Encourage knowledge sharing among emergency service:** Entities from the emergency service (e.g. police, firefighter, health service) are required to analyze together and share lessons learned and best practices from past disasters.
- **Commit to build resilience:** The city government works on the development of a resilience plan for the city and collaborates with citizens, public and private entities, emergency service to improve the resilience of the city.
- **Organize meetings about the city resilience:** The city government organizes periodically public meetings to inform and discuss with the agents of the city (citizens, public and private entities, academic and scientific entities) the evidences and improvements of the city resilience, and the challenges the city faces.
- **Enable platforms for sharing information:** The city government enables interactive platforms (web pages, social media...) for the citizens to exchange lessons learned and best practices on their experience to build resilience.
- **Establish agreements with public and private companies:** Public and private companies are required to share relevant information (e.g. emergency plans, real time images), contacts, and resources that facilitate the work of the emergency service in case of emergencies.
- **Arrange emergency drills and exercises:** Periodic emergency drills and simulation exercises are carried out to test the response capacities of the entities of the city emergency service (police, fire fighters, ambulances, health service).
- **Offer training to citizens:** Regular training, drills, and exercises are provided to all agents of the city (from government to volunteers and citizens) to improve the capacity to respond to disasters.
- **Update emergency management:** Emergency management plans are taken into account and updated regularly by the city government and the emergency service.
- **Work with risk prone communities:** Communities and neighborhoods in risk prone areas are regularly engaged in emergency management programs and activities.
- **Promote emergency preparedness at schools:** Schools are required to carry out emergency preparedness activities to learn how to deal with emergencies.

Q3: Do you think there are any police missing? If yes, please explain it.

Added Police A:	
Added Police B:	
Added Police C:	
Added Police D:	
Added Police E:	

Q4: Classify policies according to the maturity stage(s) in which they should be implemented. Please indicate how important (from 3 to 1) is to implement the policies JUST in the maturity stages in which you believe they should be implemented.

- 3 = Very important to be implemented
- 2 = Important to be implemented
- 1= Slightly important

Policies	1st stage	2nd stage	3rd stage	4th stage	5th stage	6th stage	7th stage	8th stage
<i>Example: The city government provides a webpage with information regarding the activities and plans to build city resilience.</i>			2	3				
<i>In this example the respondent considers that this policy should be implemented ONLY in the 3rd and the 4th stage. The respondent thinks that it is important to implement the policy in the 3th stage and very important in the 4th stage.</i>								

Policies	1st stage	2nd stage	3rd stage	4th stage	5th stage	6th stage	7th stage	8th stage
Establish agreements with critical infrastructures								
Organize awareness activities								
Provide opportunity to become volunteer								
Establish cooperation agreements with community organizations								
Designate an emergency coordinator								
Support resilience collaborative networks								
Require resilience plans								
Encourage knowledge sharing among emergency service								
Commit to build resilience								
Organize meetings about the city resilience								
Enable platforms for sharing information								
Establish agreements with public and private companies								
Arrange emergency drills and exercises								
Offer training to citizens								
Update emergency management								
Work with risk prone communities								
Promote emergency preparedness at schools								

Q5: After completing the questionnaire and understanding the maturity stages that have been identified, please indicate the maturity stage your city is in.

Which maturity stage and why:

Please specify any SOURCES where we can obtain more information regarding the policies and steps that your city has carried out to improve its resilience level and involve the different agents.

Thank you for your time and effort!

RESULTS FROM THE SECOND ROUND OF INTERVIEWS

Table A.1 shows, a general consensus regarding the evolution of the maturity stages was obtained. For the *unrecognized* and *initial* stages there were no doubts that these were the first and the second stages. There was also consensus that *formalized* was the third stage. However, with respect to the fourth stage, there were discrepancies among respondents as to whether it was the *supportive* or *proactive* stage. The reason for this was the confusion about the definition of the *supportive* stage. In this vein, two respondents understood that in the *supportive* stage the local government provides financial support for the development of resilience in communities, companies and households and that this did not occur until the fifth stage. However, three respondents understood this differently and they assumed that the support given by the government was not only financial support but also support for training, acquiring communication tools, etc. and that this should take place in the fourth stage.

Taking these observations into account, the description of the *supportive* stage was redefined to include not only financial support but also technical and organizational support from the local government to develop resilience. In light of this situation, it was considered that the *supportive* stage occurs after the *formalized* stage, in which a resilience unit is designed to work on building the city resilience, and before the *proactive* stage, in which stakeholders are actively involved in developing resilience.

Table A.1: Order of the maturity stages.

NAME OF THE MATURITY STAGES	ORDER					N° OF RESPONSES
	1 st stage	2 nd stage	3 rd stage	4 th stage	5 th stage	
Unrecognized	6	0	0	0	0	6
Initial	0	6	0	0	0	6
Formalized	0	0	5	1	0	6
Supportive	0	0	1	3	2	6
Proactive	0	0	0	2	4	6

E

Appendix E: Survey

This appendix shows the survey that was carried out within this research to validate the indicators to assess the implementation of the policies included in the maturity model.

INDICATORS FOR EVALUATING STAKEHOLDERS' INVOLVEMENT

In the survey we will present a set of indicators to evaluate the stakeholders' involvement in the city resilience-building process.

With stakeholders we refer to individuals, organizations or institutions such as citizens, volunteer organizations, public and private entities, and academic and educational entities that need to be involved in the resilience-building process.

The indicators are classified according to three aspects of resilience:

- (1) Level of awareness of the stakeholders on the resilience-building process.
- (2) Level of training and preparedness of stakeholders towards short and long-term shocks.
- (3) Level of learning of stakeholders from past short and long-term shocks.

We ask you to specify to what extent from 4 (Strongly Agree) to 1 (Strongly Disagree) do you agree or disagree that the suggested indicators can be useful for local governments to evaluate the involvement of stakeholders in the resilience-building process.

Furthermore, we ask you to indicate which of the indicators are already being used in your city.

We would appreciate if you could complete this questionnaire by the 17th of March.

Thank you very much for your help!

***Obligatorio**

Please include your email address *

Professional role *

To what extent do the following INDICATORS help local governments to evaluate the stakeholders' level of AWARENESS on the resilience-building process?

Resources allocated by the local government to promote resilience awareness programs *

Example: Budget allocated by the local government to carry out awareness raising activities, education programs and consultation processes with citizens.

- (1) Strongly Disagree
- (2) Disagree
- (3) Agree
- (4) Strongly Agree
- Don't Know

Resources allocated by the local government to establish and update informative channels about the resilience-building process *

Example: Personal resources or budget assigned by the local government to update information on resilience in the municipal webpage.

- (1) Strongly disagree
- (2) Disagree
- (3) Agree
- (4) Strongly agree
- Don't know

% population reached through resilience awareness raising programs *

Example: Percentage of citizens, out of the total number of citizens, that participate in resilience awareness meetings or education programs

- (1) Strongly disagree
- (2) Disagree
- (3) Agree
- (4) Strongly agree
- Don't know

Frequency of resilience meetings or presentations carried out in the city to raise awareness on resilience *

Example: Number of conferences or presentations per year that involve experts in resilience that take place in the city

- (1) Strongly disagree
- (2) Disagree
- (3) Agree
- (4) Strongly agree
- Don't know

% population consulted in the development of the city resilience plans *

Example: Percentage of citizens, out of the total number of citizens, that participate in consultation process to develop the city resilience plan

- (1) Strongly disagree
- (2) Disagree
- (3) Agree
- (4) Strongly agree
- Don't know

N° of followers in resilience informative websites *

Example: Number of stakeholders that follow resilience informative websites

- (1) Strongly disagree
- (2) Disagree
- (3) Agree
- (4) Strongly agree
- Don't know

N° of collaboration agreements between the local government and stakeholders to promote building resilience *

Example: Number of collaboration agreements with volunteer organizations per year to foster awareness on emergency preparation in neighborhoods.

- (1) Strongly disagree
- (2) Disagree
- (3) Agree
- (4) Strongly agree
- Don't know

What other indicators can be used to evaluate the level of awareness?

Please select the indicators that you are already using in your city *

- Resources allocated to promote awareness programs
- Resources allocated to update informative channels
- % of population reached through awareness raising programs
- Frequency of resilience meetings or presentations
- Frequency of resilience education programs
- % of population consulted in the development of the resilience plans
- N° of followers in resilience informative websites
- N° of collaboration agreements to foster resilience

To what extent do the following INDICATORS help local governments to evaluate the stakeholders' level of TRAINING AND PREPAREDNESS about the resilience-building process?

Resources allocated to develop emergency and training exercises *

Example: Personal resources allocated by the local government to carry out emergency drills

- (1) Strongly disagree
- (2) Disagree
- (3) Agree
- (4) Strongly agree
- Don't know

N° of stakeholders/organizations that share resilience plans with the local government *

Example: Number of private companies that share their resilience/emergency plans with the local government

- (1) Strongly disagree
- (2) Disagree
- (3) Agree
- (4) Strongly agree
- Don't know

% of population that receives incentives to develop and implement resilience actions *

Example: Percentage of citizens out of the total number of citizens that receive incentives such as grants by the local government to improve their resilience level

- (1) Strongly disagree
- (2) Disagree
- (3) Agree
- (4) Strongly agree
- Don't know

Degree of implementation of the city resilience plan *

Example: Status of the city resilience plan such as developed, accepted, published, implemented, or reviewed and updated.

- (1) Strongly disagree
- (2) Disagree
- (3) Agree
- (4) Strongly agree
- Don't know

Frequency of multi-stakeholder training exercises *

Example: Number of training exercises per year undertaken between the local government and emergency services.

- (1) Strongly disagree
- (2) Disagree
- (3) Agree
- (4) Strongly agree
- Don't know

% of population trained *

Example: Percentage of citizens, out of the total number of citizens, that receive training on emergencies and risk reduction measures.

- (1) Strongly disagree
- (2) Disagree
- (3) Agree
- (4) Strongly agree
- Don't know

What other indicators can be used to evaluate the level of training and preparedness?

Pleas select the indicators that you are already using in your city

- Resilience allocated to develop and implement resilience actions
- N° of stakeholders that share resilience plans with the local government
- % of the population that receives incentives
- Degree of implementation of the city resilience plan
- Frequency of multi-stakeholder training exercises
- % of population trained

To what extent do the following INDICATORS help local governments to evaluate the stakeholders' level of LEARNING about the resilience-building process?

Resources allocated to establish multi-stakeholder debriefing meetings on resilience-building *

Example: Budget allocated by the local government to arrange debriefing meetings between different stakeholders such as emergency services, CIs, private companies, and volunteer organizations.

- (1) Strongly disagree
- (2) Disagree
- (3) Agree
- (4) Strongly agree
- Don't know

Resources allocated to establish platforms to share lessons learned on the resilience-building process. *

Example: Budget allocated by the local government to establish platforms that allow stakeholders (citizens, emergency services) to share information and best practices on resilience.

- (1) Strongly disagree
- (2) Disagree
- (3) Agree
- (4) Strongly agree
- Don't know

% of population involved in multi-stakeholder debriefing meetings on resilience *

Example: Percentage of volunteer organizations out of the total number of volunteer organizations involved in debriefing meetings arranged by the local government to reflect on the resilience-building actions that need to be implemented in the city.

- (1) Strongly disagree
- (2) Disagree
- (3) Agree
- (4) Strongly agree
- Don't know

Frequency of multi-stakeholder debriefing meetings on resilience *

Example: Number of debriefing meetings arranged by the local government and other stakeholders (emergency services or volunteer organizations) per year to reflect and decide on the resilience-building process.

- (1) Strongly disagree
- (2) Disagree
- (3) Agree
- (4) Strongly agree
- Don't know

N° of users of the resilience platforms *

Example: Number of users that use the resilience platforms established by the local government to provide and receive information on the resilience-building process.

- (1) Strongly disagree
- (2) Disagree
- (3) Agree
- (4) Strongly agree
- Don't know

N° of lessons learned implemented with respect to the lessons learned identified *

Example: Number of lessons learned that have been implemented by the local government with regards to the resilience-building process.

- (1) Strongly disagree
- (2) Disagree
- (3) Agree
- (4) Strongly agree
- Don't know

What other indicators can be used to evaluate the level of learning?**Select the indicators that you are already using in your city**

- Resources allocated to establish debriefing meetings on resilience
- Resources allocated to establish platforms to share lessons learned on resilience
- % of population involved in multi-stakeholder debriefing meetings
- Frequency of multi-stakeholder debriefing meetings
- N° of users of the resilience platforms
- N° of lessons learned implemented with respect to the ones identified

Appendix F: Implementation Questionnaire

This appendix shows the implementation questionnaire that was used in the case studies. The questions aim at gathering evidence of the policies implemented and their implementation temporal order in the cities under study.

QUESTIONNAIRE	EVIDENCE FOR THE POLICIES
Unrecognized stage	
<ul style="list-style-type: none"> - What channels are there (i.e. municipal website, social media) to inform city stakeholders about potential disasters? - Are there media channels contacted to broadly inform citizens about potential warnings and disaster? 	Policy 1.1
<ul style="list-style-type: none"> - What type of agreements are there to collaborate with emergency services for mitigation, preparation, response, recovery activities? - Does the local government help with the emergency services to develop plans? 	Policy 1.2
<ul style="list-style-type: none"> - Are regular training exercises carried out with the emergency services to improve the efficiency of response in case of disasters? 	Policy 1.3
<ul style="list-style-type: none"> - Are post-disaster evaluations carried out between the emergency services and local government to improve disaster plans? 	Policy 1.4
Initial stage	
<ul style="list-style-type: none"> - Do companies and citizens in risk-prone areas receive prevention training (i.e. identification of safe places, explanation on disaster procedures and plans)? 	Policy 2.1
<ul style="list-style-type: none"> - Are there collaboration agreements with CIs in place to share emergency plans, contact details, and resources? - Are training exercises and drills arranged with CIs? 	Policy 2.3
<ul style="list-style-type: none"> - Are there collaboration agreements with volunteer organizations to involve them in disaster management phases? - Are training exercises and drills arranged with volunteer organizations? 	Policy 2.3
<ul style="list-style-type: none"> - Are there procedures or platforms to share lessons learned on past disasters between the emergencies services, volunteer organizations and CIs? 	Policy 2.4
Formalized stage	
<ul style="list-style-type: none"> - How often does the local government collaborate with academic, educational and scientific entities or volunteer organizations to promote awareness on building resilience? 	Policy 3.1
<ul style="list-style-type: none"> - Have working groups been established with representatives from the different stakeholders to identify the actions that need to be included in the resilience strategy? - How often do stakeholders involved in the working groups come together? 	Policy 3.2

- Are the roles of the different stakeholders that contribute to the resilience-building process defined in a strategy?	Policy 3.3
- Are multi-stakeholder debriefing meetings arranged periodically to learn on multiple disaster types?	Policy 3.4
Supportive stage	
- Does the local government formal or informal agreements with the local media (i.e. radio, television...) to disseminate the city resilience strategy ?	Policy 4.1
- Has the city resilience strategy been presented to the public (such as conference, events, public platforms or municipal website)?	Policy 4.2
- Is there a public platform to provide information about the city resilience strategy?	
- What type of incentives does the local government provide for the implementation of resilience actions (e.g. awards, prizes, etc.)?	Policy 4.3
- Is there a multi-stakeholder committee with representatives for the city stakeholders to evaluate and monitor the city resilience?	Policy 4.4
- How often do stakeholders involve in the committee meet?	
- Which indicators are used to monitor the implementation of the city resilience strategy?	
Proactive stage	
- Is there two-way communications for citizens to provide feedback on the resilience-building process?	Policy 5.1
- Does the local government provide basic training and exercising opportunities to citizens?	Policy 5.2
- Is any certification provided to companies that have standards for resilience management?	Policy 5.3
- Have representatives from citizens and companies being involved in multi-stakeholder committees to monitor and evaluate the effectiveness of the city resilience strategy?	Policy 5.4
- Are there platforms to enhance sharing of resilience lessons learned and best practices among city stakeholders?	

P Publications

In this chapter the publications achieved as a result of this research are included. The publications are classified by the different types of publications: conference publications, journal publications, and book chapters.

Conference Publications

Authors: Raquel Gimenez, Leire Labaka, & Josune Hernantes.

Title: Building City Resilience Through Collaborative Networks: A Literature Review

Conference: International Conference on Information Systems for Crisis Response and Management in Mediterranean Countries (ISCRAM Med).

Place and date of the Conference: Madrid, Spain. October 2016.

Authors: Raquel Gimenez, Leire Labaka, & Josune Hernantes.

Title: Enhancing Organizational Resilience through Virtual Communities of Practice.

Conference: 25th European Safety and Reliability Conference (ESREL).

Place and date of the Conference: Zurich, Switzerland. September 2015.

Authors: Raquel Gimenez, Leire Labaka, Jose Mari Sarriegi & Josune Hernantes.

Title: Development of a Community of Practice on Natural Disasters.

Conference: 12th International Conference on Information Systems for Crisis Response and Management (ISCRAM).

Place and date of the Conference: Kristiansand, Norway. May 2015.

Authors: Raquel Gimenez, Josune Hernantes, Leire Labaka, Jose Mari Sarriegi, & Ana Laugé.

Title: Developing a Community of Practice to Learn, Share and Improve in Emergency Management.

Conference: 15th European Conference on Knowledge Management (ECKM 2014).

Place and date of the Conference: Santarem, Portugal. September 2014.

Journal Publications

Authors: Raquel Gimenez, Leire Labaka, & Josune Hernantes.

Title: A Maturity Model for the Involvement of Stakeholders in the City Resilience Building Process.

Journal: Technological Forecasting and Social Change.

Year: 2017

Volume: 121

Pages: 7-16

Authors: Raquel Gimenez, Leire Labaka, & Josune Hernantes.

Title: Union Means Strength: Building City Resilience through Multi-Stakeholder Collaboration

Journal: Journal of Contingencies and Crisis Management.

Year: 2017

Volume: In press

Pages:

Authors: Raquel Gimenez, Josune Hernantes, Leire Labaka, Star Roxanne Hiltz, & Murray Turoff.

Title: Improving the Resilience of Disaster Management Organizations through Virtual Communities of Practice: A Delphi Study.

Journal: Journal of Contingencies and Crisis Management.

Year: 2017

Volume: 25 (3)

Pages: 160-170

Authors: Raquel Gimenez, Leire Labaka, Jose Mari Sarriegi, & Josune Hernantes.

Title: Mejorando el Intercambio de conocimiento sobre Desastres Naturales: El Valor de las Comunidades de Práctica.

Journal: Revista de Ingeniería e Industria (DYNA).

Year: 2016

Volume: 91 (2)

Pages: 146-150

Book Chapters

Authors: Raquel Gimenez, Leire Labaka, Jose Mari Sarriegi, & Josune Hernantes,

Chapter Title: A Virtual community of Practice to Learn about Natural Disasters: Opportunities and Challenges.

Book Title: Natural Disasters: Risk Assessment, Management Strategies and Challenges.

Editors: NOVA Science Publishers.

Year: 2016

Place: New York

Pages: 129-141

Authors: Raquel Gimenez, Josune Hernantes, & Jose Mari Sarriegi.

Chapter Title: Developing a Community of Practice in Emergency Management.

Book Title: ELITE International Scientific Conference on Best Practices and Lessons Learned

Editors: Paweł Kępk

Year: 2014

Place: Warsaw, Poland

Pages: 57-66
