SMART MATURE RESILIENCE

DELIVERABLE 2.6: PRELIMINARY RESILIENCE MATURITY MODEL

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EXECUTIVE SUMMARY

The main aim of the SMR project is to develop a Resilience Management Guideline able to help in the operationalisation of the resilience building process of any European city. This Guideline integrates five complementary tools that will enhance significantly the ability of the European region that is exposed to natural and other hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including the preservation and restoration of its essential basic structures and functions. These five tools are: 1) a Resilience Maturity Model, 2) a Risk Systemicity Questionnaire, 3) a Portfolio of Resilience Building Policies, 4) a System Dynamics Model and 5) a Resilience Engagement and Communication tool.

This report focuses on the first tool explaining the methodology used to develop it in addition to describe its maturity stages. Group Model Building workshops have been arranged during the SMR Project first year to gather from experts the needed information for the development of this Preliminary Resilience Maturity Model. Then, a Delphi process has been carried out to validate the Maturity Model.

The Preliminary Resilience Maturity Model comprises five maturity stages to guide cities through the ideal path of building resilience. Each maturity stage contains a description of the objectives of that maturity stage, the stakeholders that need to be engaged in each stage in addition to a list of policies that must be developed to achieve the objectives defined in that maturity stage. This tool will be used by local governments and other stakeholders in order to assess and classify themselves in their corresponding maturity stage. Once CITIES know in which maturity stage they are, the maturity model will help them to identify the optimal path for the evolution of the resilience building process.

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1. INTRODUCTION

The severe consequences of the natural disasters that we have suffered in the last two decades such as the Indian Ocean tsunami in 2004, the Katrina and Sandy hurricanes in 2005 and 2012, the Haiti Earthquake in 2010, the East Japan Great Earthquake and Tsunami in 2011 and the most recent earthquake in Nepal in 2015, have overwhelmed the response capacity of cities. Moreover, the perspective for the next decades is not satisfactory, since it is expected that the number of disasters will continue increasing due to climate change and dense settlements in coastal and other disaster-prone areas. In addition, the dependency of current society on critical infrastructures and their interdependency, may contribute to rapidly escalate the effects, magnitude and impact of disasters.

Nowadays, the majority of the world's population live in cities, and according to forecasts, an increasing number of people will live in cities in the coming decades (100 Resilient Cities, 2016; Prior et al, 2013). As cities continue to grow, there is an urgent need to work toward building cities' resilience to the effects of a wide spectrum of disasters, ranging from acute shocks such as floods, droughts, and earthquakes to chronic shocks such as climate change, or environmental pollution (Godschalk, 2003; Prior et al, 2013; Weichselgartner and Kelman, 2014).

Resilience thinking supports disaster management to transition to an all-hazards approach, placing the emphasis on the ability of a complex system to deal with shocks and long-term stresses (Singh-Peterson et al., 2015). Resilience management expands the scope of risk management, in addressing complexities that characterise the operation of large integrated systems, considering known as well as unforeseen threats (Linkov et al. 2014). In this respect, the creation of more resilient cities or communities involves to withstand and recover from shocks and stresses, being able to adjust plans and procedures prior to, during and following new or unexpected disturbances, so that they can maintain their function as needed throughout the disruption (Hollnagel, 2009).

Current literature and international initiatives such as the Rockefeller Foundation and the United Nations Office for Disaster Risk Reduction (UNISDR) provide a broad set of frameworks, which include characteristics and priorities for building resilient cities (Johnson et al. 2014; Shaw, 2012; UNISDR, 2005; UNISDR, 2015; 100 Resilient Cities, 2016). However, there is still the need to provide guidance for the operationalization of resilience providing a practical application of resilience concepts in decision making and planning. Operationalization entails making resilience concepts useful and useable beyond their theoretical context to policy makers and managers. In order to find a way to address this need, the SMR project is developing and validating the Resilience Management Guideline. This Resilience

Management Guideline consists of five complementary tools that will enhance the anticipation and the coordination across different stakeholders and will enable addressing risks and opportunities in order to facilitate planning and decision-making process. These five tools are: 1) a Resilience Maturity Model, 2) a Risk Systemicity Questionnaire, 3) a Portfolio of Resilience Building Policies, 4) a System Dynamics Model and 5) a Resilience Engagement and Communication tool.

This deliverable focuses on the first tool, the Resilience Maturity Model. The SMR project has developed a preliminary version of a Maturity Model that defines incremental stages which guide CITIES through the optimal path for building resilience taking into account the definition of City Resilience developed within the SMR project scope. City Resilience has been defined as **"the ability of a CITY or region to resist, absorb, adapt to and recover from acute shocks and chronic stressed to keep critical services functioning, and to monitor and learn from on-going processes through city and cross-regional collaboration, to increase adaptive abilities and strengthen preparedness by anticipating and appropriately responding to future challenges".**

The SMR Maturity Model defines five maturity stages: Starting, Moderate, Advanced, Robust, and verTebrate1. And, each of these maturity stages includes a description of the objectives of each stage, the agents involved in each maturity stage in addition to a set of resilience building policies to implement in order to reach de objective of each stage and move forward with next stages.

The document is structured as follows. Section 2 presents a brief overview of the state of the art on Maturity Models. Section 3 describes the methodology followed in order to implement the preliminary version of the Maturity Model while the components of the Maturity Model developed in this project are explained in Section 4. Section 5 contains a complete description of the five maturity stages and their components. It defines the maturity stages and the sequential order in which they occur, as well as the policies that the local government and other relevant stakeholders need to implement in each maturity stages. Finally, the relevant conclusions are presented in Section 6.

1 The initials of the first four maturity stages with the 'T' of the last stage set up the SMART acronym, that is the first word of the name of this project: 'SMART Mature Resilience (SMR)'.

2. STATE OF THE ART

Worldwide there have been twice as many disasters and catastrophes in the first decade of this century than in the last decade of the 20th Century (Government and Disaster Resilience Minitrack, 2016). During the aftermath of these disasters, the need for improving our ability to manage and assess the cities' resilience emerges. However, how to best deal with already known risks and prepare for the unexpected ones is an enormously complex activity and still nascent.

Therefore, despite the importance of improving cities resilience, currently there are limited examples of the sequential steps that cities should follow in developing resilience (Molin Valdés et al., 2013). Furthermore, not all cities have the same resilience level, and there is a lack of guidance on which policies should be implemented as function of the current situation of a city (Oteng-Ababio et al., 2009). In addition, there is little understanding of how the different stakeholders of a city should work and collaborate to develop the city's resilience (Singh-Peterson et al., 2015). In this context, the SMR project presents a maturity model that provides an ideal sequence of maturity stages that can guide local government in resilience building process.

Maturity models serve to identify the ideal path for the evolution of a process from an initial stage to a more advanced stage, passing through a number of intermediate stages (Becker et al., 2009; Wendler, 2012). Maturity model consists of a structured collection of elements that describe the characteristics of effective processes from the bottom stage of maturity to the highest level of maturity. Furthermore, maturity models provide criteria and characteristics that need to be fulfilled by an organization to reach a particular maturity level. During maturity appraisal, a snap-shot of the organization regarding the given criteria is made (Becker, Knackstedt et al. 2009).

The objective of maturity models is therefore, to describe the trajectory of an organization over time through stages of increasing maturity measured by capability to perform some process (Wendler 2012). The bottom stage stands for an initial stage that can be, for instance, characterized by an organization having little capabilities in the domain under consideration. As the stage increases, activities are performed more systematically and are better defined and managed (Fraser, Farrukh et al. 2003). Therefore, the highest stage represents a conception of total maturity and advancing on the evolution path between the two extremes involves a continuous progression regarding the organization's capabilities or process performance.

Although maturity models have their origin in quality management, a systematic mapping study, published in 2012, surveying the use of maturity models until 2010 identified articles in scientific journals and conferences on uses of maturity models in nearly two dozen application domains (Wendler 2012). Software development and software engineering were by far the most popular application areas with a total of 89 articles. Applications in public sector, project management, other business areas, engineering and knowledge management and process management appeared in more than ten papers each. Other applications included engineering, outsourcing, medical sector, supply chain management, business functions, business intelligence, collaboration processes, finance/controlling, IT functions, IT governance, IT alignment, leadership and sustainability (Wendler 2012, Figure 3, p. 1328). In recent years, maturity models have been developed and validated in new domains, including environmental management and information security (Rigon et al. 2014).

Despite their differing purpose, for example as a tool for continuous improvement or as a means for the assessment and benchmarking, maturity models classify and assess institutional, organizational and or technical capabilities of an organization or information system that provide certain beneficial effects according to the corresponding maturity level (Frick, Kuttner et al. 2013). The use of maturity models generates an awareness of the analyzed aspects: their state, importance, potentials, requirements, complexity, and so on. Furthermore, the maturity models may serve as reference frame to implement a systematic and well directed approach for improvements, ensure a certain quality, avoid errors, and assess one's own capabilities on a comparable basis (Wendler 2012). In line with this, maturity models are used as an evaluative and comparative basis for improvement and in order to derive an informed approach for increasing the capability of specific area within an organization (Bruin et al, 2005). Actually, maturity models should be sufficient to support organizations in the assessment of their maturity level and capabilities to conduct inter-organizational integration by the identification of beneficial effects corresponding to each maturity level and the enactment of necessary measures to overcome existing impediments of preventing inter-organizational activities (Frick, Kuttner et al. 2013).

Given the identified gaps on the resilience operationalization process and taking into account the characteristics of maturity models, the SMR project has developed a Resilience Maturity Model that comprises five well-defined maturity stages to guide cities through the ideal path of building resilience. Cities will start from stage one, and from there move on to a more advanced stage, passing through a number of intermediate stages. Therefore, the Resilience Maturity Model will provide guidance to cities on the specific resilience building policies that they have to implement in each of the maturity stages. The implementation of these policies will allow the cities to move forward from one stage onto the next.

3. METHODOLOGY

The development of the Preliminary Resilience Maturity Model has been carried out in an iterative way, improving it continuously until reaching the preliminary version described in this deliverable. The first phase consists of a conceptualization.

Before starting with the development of the Maturity Model a conceptualization phase was carried out through a literature review. The objective of this conceptualization phase was to obtain an overview of current practice in urban resilience and EU sectoral resilience approaches, to identify, synthesise and assess the main challenges and best practice of today. As a result of this phase, deliverables D1.1, D1.2 and D1.3 were obtained.

For the development of the Preliminary Resilience Maturity Model, four Group Model Building (GMB) workshops were arranged, and the main content of the maturity model was gradually developed with the information gathered during these workshops. Rotterdam and Vejle resilience strategies have also been reviewed in order to gather information to develop the Resilience Maturity Model[2]. Finally, Delphi methodology has been used to validate the SMR Maturity Model with additional experts external to the project (Figure 1).

The next sub-sections elaborate further each method employed to formulate SMR Maturity Model.

[2] Vejle's Resilience Strategy (2016). http://www.100resilientcities.org/page/-/100rc/Vejles_resilience_strategy_webquality_160316.pdf

Rotterdam's Resilience Strategy (2016). http://www.resilientrotterdam.nl

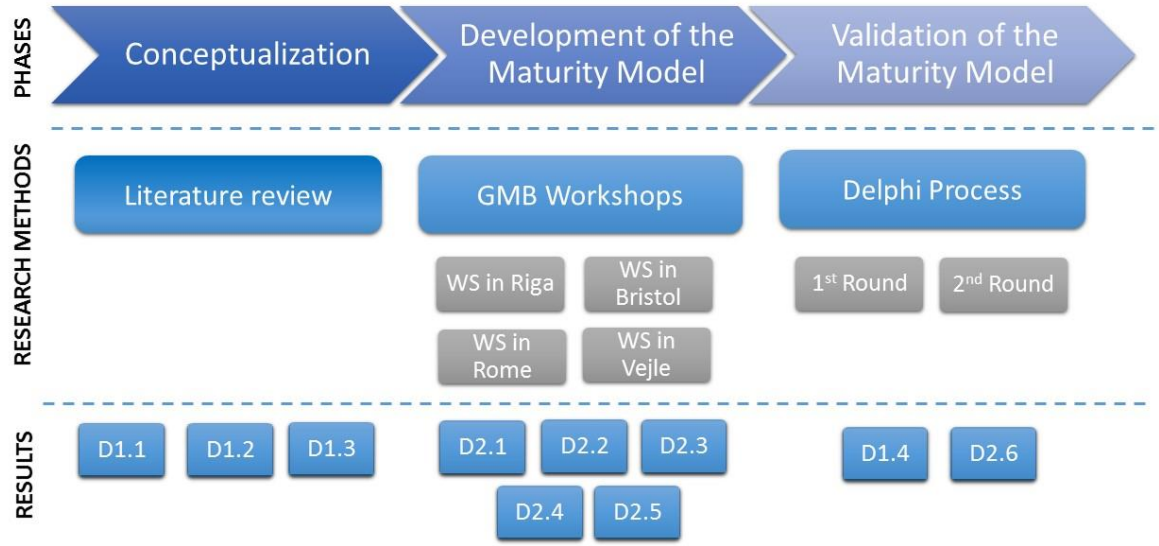

Figure 1: Methodology to develop and validate the SMR Maturity Model

3.1. Group Model Building

Group Model Building (GMB) is a collaborative methodology which enables integrating fragmented knowledge, initially residing on the minds of different agents, into aggregated models (Richardson and Andersen, 1995). Through different exercises such as stakeholders' analysis, policies and indicators identification, modellers were able to integrate experts' fragmented knowledge and gain insights to the problem (Andersen et al., 1997; Andersen et al., 2007; Rich et al., 2009).

Four workshops were arranged between October 2015 to May 2016 in the city of Riga, Bristol, Rome and Vejle in the field of Critical Infrastructures (CIs), Climate Change and Social Issues. The SMR consortium employed the GMB methodology to gather knowledge about the problem areas from domain experts. The workshops provided a wealth of information about different aspects of each problem area which was then used as an input for developing the maturity model. In the first workshop (Riga, 26th-29th October 2016), SMR acquired information about dependencies of cities on CIs defining the most relevant milestones occurred in the history related to CI dependency; the relevant indicators to assess the resilience level of the cities regarding their dependency towards CIs, and the Behaviour over Time (BOT) graphs. For further results, see Deliverable D2.1.

The second workshop (Bristol, 25th-28th January 2016) identified a wide range of policies, indicators and barriers about Climate Change and resilience. The workshop in Bristol also pinpointed the first indication on the dynamics of building resilience, and identified the evolution of the main policies and which policies need to be implemented first. Following steps regarding the development of the maturity model were to reaching consensus on which specific stage the different policies need to be implemented. Complete documentation of the results obtained in the workshop of Bristol can be found in Deliverable 2.2.

The third workshop (Rome, 22nd-25th February 2016) resulted in a better definition of the specific stages of the city-resilience preliminary maturity model and suggested relevant indicators to measure the resilience level in a particular stage and throughout the whole process. These results were valuable and contributed to comprehend better the dynamics of building resilience. Further results can be found in Deliverable 2.3.

Finally, the fourth workshop (Vejle, 9th to 12th May 2016) focused on consolidating, integrating and validating the results obtained in the previous workshops on Critical Infrastructures, Climate Change, and social issues. The main focus was to validate the identified policies in each stage of the maturity model, and provide feedback for the proposed definition of the city resilience. As a result of the workshop, a better definition of the policies that need to be implemented in the specific stages of the city-resilience preliminary maturity model was obtained. The results also served to understand better the dynamics of building resilience. Overall results are documented in the Deliverable 2.4.

3.2. The Delphi Method

Based on the results presented in the deliverables D1.1, D1.2 and D1.3 and the information gathered from experts during the four workshops conducted in WP2 using the Group Model Building methodology, the SMR project has developed its own definition of City Resilience in addition to a preliminary version of the Maturity Model. These results have been validated using a Delphi methodology involving multidisciplinary experts with experience in different areas of resilience (Critical Infrastructure, Climate Change, Social Issues) and different levels (City representatives/governance and the European Dimension of resilience).

The Delphi method is a systematic and iterative process for structuring a group communication process that aims at conducting detailed examinations and discussions of a specific issue for the purpose of goal setting, policy investigation, or predicting the occurrence of future events (Ulschak, 1983; Turoff & Hiltz, 1996; Ludwig, 1997). Delphi, in contrast to other data gathering and analysis, techniques, employs multiple iterations to obtain a consensus of opinion concerning a specific topic. Iterations refer to the

feedback process. The process has a series of rounds, and in each of these rounds every participant works through a questionnaire which is returned to the researcher who collects, edits, and returns to every participant a summary of all the comments made by each participant to be aware of the range of opinions and the reasons underlying those opinions (Ludwig, 1994).

In the case of SMR project, the Delphi consisted of two rounds. The purpose of the first round was to validate the City Resilience definition as well as the description of the five stages defined in the preliminary version of the Maturity Model. In addition to this, experts were asked to identify to what extent stakeholders should be involved in each of these five stages of the Maturity Model. In the second round of the Delphi process, participants were asked in first place to re-evaluate the experts' answers from the first questionnaire where experts did not reach a consensus. Secondly, they had to classify a set of resilience building policies considering the maturity stage where they should start their development to guarantee their effectiveness in the resilience building process. After these two rounds, experts were provided with an anonymous summary of the opinions gathered in the first and second rounds so they could review this summary of results and see their own answers with regards to other participants' answers. Deliverable 1.4 provides further details about the process and the obtained results.

4. USAGE AND STRUCTURE OF THE PRELIMINARY RESILIENCE MATURITY MODEL

4.1. Usage of the Preliminary Maturity Model

The SMR Preliminary Maturity Model defines a sequence of five maturity stages CITIES pass through from their initial efforts in resilience building process towards the achievement of resilience excellence. Therefore, this Maturity Model serves to guide CITIES through the optimal path of building resilience, being the municipality or the multi-level governance the end-users of this tool.

As it was explained in the Deliverable 2.5, the SMR Maturity Model is defined at a strategic level, where each stage represents a generic characterization of the resilience building process and could be applied to any CITY. The resilience building policies included in each maturity stage are also described using a high-level approach due to this tool's strategic approach and its target end-users. These resilience building policies included in the Maturity Model will be afterwards particularized for each CITY context and characteristics in the Portfolio of Resilience Building Policies tool[3], which aims to provide support at a tactic or operative level. Following some characteristics to consider during the particularization process to carry out in each CITY during the Maturity Mode implementation are explained (Figure 2):

- **Population:** different aspects must be considered related to population. Population density in an urban area makes cities especially vulnerable both to the impacts of shocks and stresses. For instance, the number of people and critical services affected due to a blackout is exponentially bigger in cities than in rural areas.
  The average age of citizens, the percentage of economically active population, percentage of citizens with higher education, and percentage of immigrants are also relevant indicators to

[3] The Portfolio of Resilience Building Policies tool will provide insights to adequate the generalist policies presented in the Maturity Model into more specific policies designed for the context of each CITY. This tool is part of the Resilience Management Guideline proposed by SMR project.

consider in order to particularize the Maturity Model since they provide information about the current and future problems of the city.

- **Geographical location**: the location of a city can influence the probability of suffering certain type of shocks and stresses. For instance, Donosti-San Sebastian is a coastal city with propensity for huge waves and consequently wave damage and flooding. On the other hand, Rome is more likely to suffer the effect of an earthquake because of its location in a seismic active area.
- **Vulnerabilities:** It is of paramount importance for each city to assess its particular challenges in order to know the type of shocks and stresses that it can suffer from and to identify the correct actions to implement to avoid or at least minimize their effects.
- **Governance**: the government is a key element in the resilience building process. It must guarantee the delivery of services and resources, respond to shocks and stresses and provide security. The government is in charge of implementing new legislation and regulation to promote the resilience building process.
- **Economic situation:** cities that invest in public infrastructure, planning systems, and support for employment growth can increase their resilience significantly, thus improving long-term investment prospects. On the other hand, cities in developing country face high chances of suffering shocks and stresses due to their relative lack of resources to guarantee the social welfare and increase the quality of infrastructures and adapt them to deal with these events. Indicators as unemployment rate, local GDP, business activity, investments in R&I and the budget the city council manages enable to analyze the economic situation of a city.
- **Quality of infrastructures:** guaranteeing a high level of performance of the facilities that are critical to the citizens' health and welfare is really crucial to deal with shocks and stresses. Energy, transport, communications and health are examples of these critical services. Concrete actions must be implemented towards the promotion of quality infrastructure investment to increase their redundancy, reliability and flexibility.

  Apart from the critical services, the overall city infrastructure needs to be able to withstand a shock or easily to be restored if it is damaged during a shock. The city's urban plan should define measures to adapt the infrastructures (houses, buildings…) located in particularly vulnerable areas and to build new infrastructures using technologies that can minimize the effect of shocks. This is the case of Japan, where the buildings must meet earthquake-safe building codes.
- **Quality of life- Social cohesion:** it is "the capacity of a society to ensure the welfare of all its members, minimising disparities and avoiding polarisation". The strength of relationship

between neighbors is an indicator of how well communities will adapt when a shock occurs. In those situations, citizens cooperate to achieve shared well-being. It is important to build also social cohesion when living with communities from a variety of cultures, ethnicities, languages and abilities. Immigration's influence on social cohesion is one of the major challenges for Europe's future. Successful integration of immigrants is a prerequisite for social cohesion and economic progress.

Indicators such as crime rate, poverty and integration programs among others are also crucial measurements to assess the quality of life of a city.

Figure 2: Context characteristics of a city

Each CITY has been performing specific actions towards resilience in different ways. Some of them have been working for several years on the concept of resilience while others have just started. Therefore, the requirements each of the CITIES have are not the same. In fact, a CITY that has been developing resilience building activities for several years will require different activities than a CITY that has just started the path of developing this concept. Thus, the local governments can use the SMR Maturity Model in order to assess and classify themselves in their corresponding maturity stage considering the efforts made in the resilience building process. Once they identify their corresponding

maturity stage, the Maturity Model will guide the CITIES through their optimal path in the resilience building process. Following the suggested implementation order of the resilience building policies, CITIES will find the most effective way to advance in the resilience building process and improve their resilience level to deal with shocks and stresses.

It may be the case that CITIES are not able to classify themselves in a single maturity stage. This can happen since they have developed policies from different maturity stages but without completing all the policies of those maturity stages. Another reason can be that they have reached different resilience levels depending on the topic (Critical Infrastructures, Climate Change or social issues). In these cases, although they are not able to classify themselves in one specific maturity stage, the Maturity Model may provide local governments with useful information about the policies they need to implement in order to make progress on the maturity stages and achieve a higher resilience level. Actually, in these cases they should consider the less mature stage where CITIES have not completed the development of all the policies as a starting point in their path to build resilience, since one CITY is not considered to have reached one maturity stage until it has developed all the policies defined in that maturity stage.

The Preliminary Resilience Maturity Model will be tested in a pilot implementation in the three partner CITIES Donostia, Glasgow and Kristiansand (Work Package 5) providing new insights that will be included in the revised version of the Maturity Model that will be developed in Task 3.1 (Deliverable D3.1).

4.2. Structure of the Preliminary Resilience Maturity Model

Each of the five maturity stages defined in the SMR Maturity Model presents the following components (see Figure 3):

- **Description**: The model presents a description of what the objective of each of the stages are, so the cities could know what needs to be achieved in each stage.
- **Agents involved**: The progression of the involvement of the agents in the resilience building process is fundamental. Consequently, we have given importance to present the agents that should be involved in each of the stages.
- **Policies**: The actions that cities should take to complete each of the stages have been exposed, so they could know exactly what steps they should take to reach the objective of each stage.

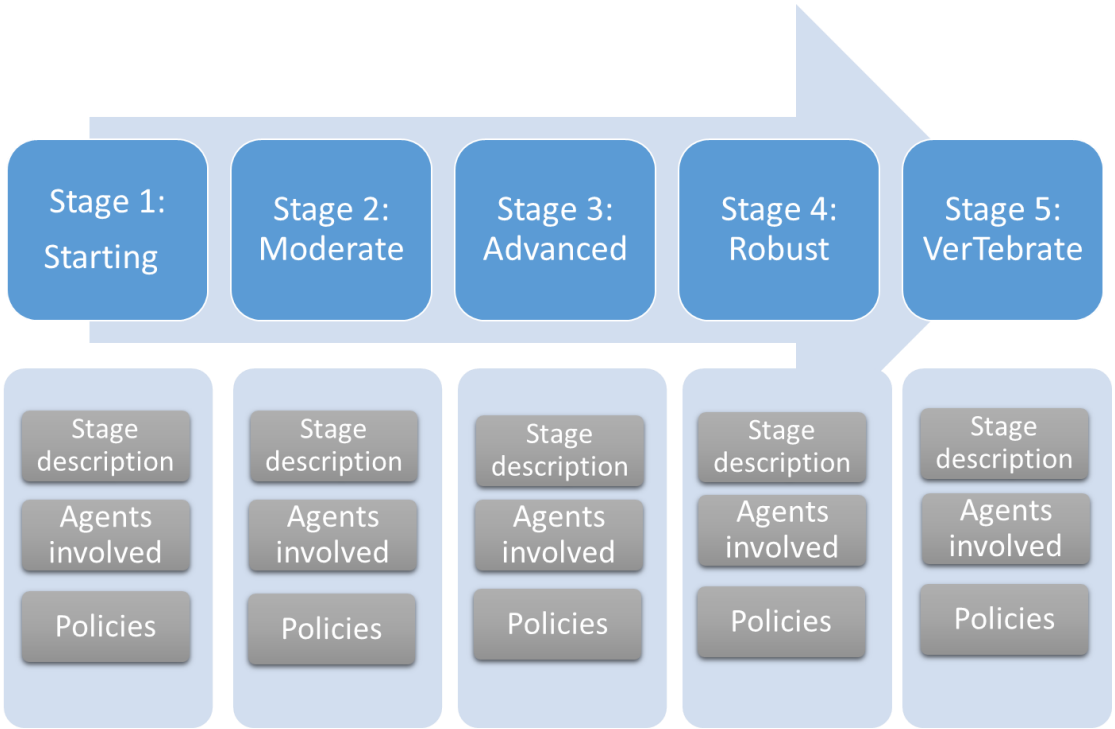

Figure 3: SMR Maturity Model elements

Following sections will describe these components of the Maturity Model with further detail.

4.2.1. STAGE DESCRIPTION

Each maturity stage in the model presents a description of its objective, so the cities could know clear where to focus on. As the cities progress through on the maturity stages, they will mature from low resilience to high resilience as vertebrae of European resilience.

As it was explained in the proposal, the overall objective of the SMR project is to develop, test and demonstrate a pilot of European Resilience Management Guideline that will increase significantly the ability of the European region 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.

The SMR project presents a holistic approach where cities are not considered as isolated entities, but rather as interconnected and interdependent units that play a key role for Europe's resilience, having the potential to become Europe's resilience backbone. The analogy of the 'European resilience

backbone' means that a crisis that affects significantly one city in Europe might expand its consequences to the whole continent through cascading effects. Consequently, efforts made in the cities involved in this project will help to increase other cities' resilience level and the overall resilience level of Europe. Within the SMR approach, cities are considered vertebrae in a strong European resilience backbone (see Figure 4).

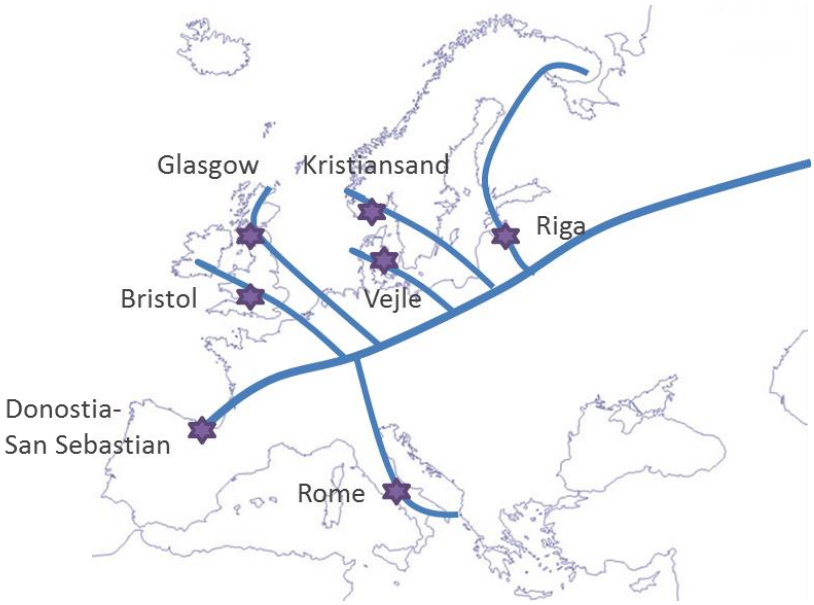

Figure 4: SMR European backbone concept

4.2.2. AGENTS INVOLVED

Building city resilience is a complex process that requires the commitment and engagement of numerous stakeholders progressively and from every sector (Dieleman 2013; Malalgoda et al. 2013). For instance, governments have the responsibility of developing right policies, plans and investing in infrastructures while businesses ensure the functioning of our economic systems.

City stakeholders are the individuals, groups or organizations from various disciplines and with different needs, responsibilities and resources that are involved in the resilience building process. In this context, the SMR project defines the concept of CITY (in capital letters) as an environment that involves all the relevant stakeholders in the resilience building process (Figure 5).

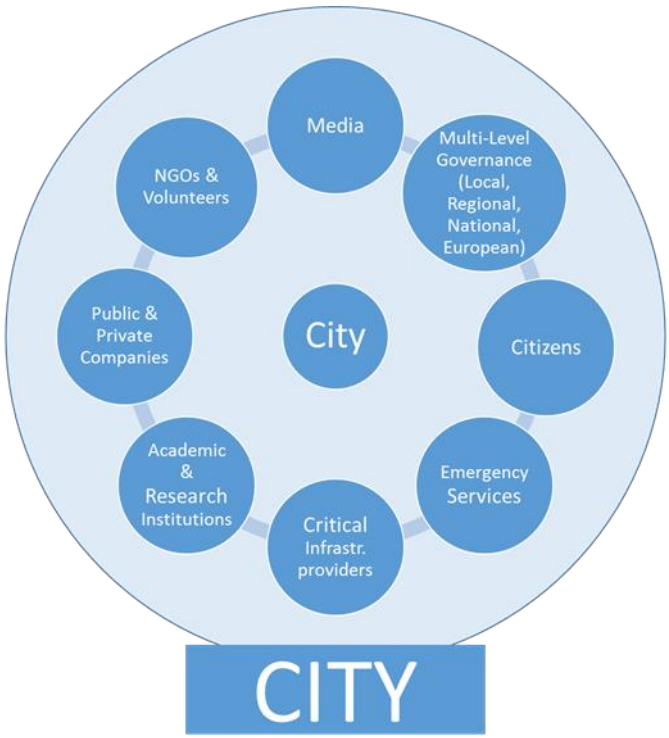

Figure 5: CITY concept – a city that involves all the relevant stakeholders in the resilience building process

The progressive involvement of the stakeholders is considered in the description of the maturity stages. Thus, city (in small letters) is used in the first three maturity stages since all the relevant stakeholders are not still involved in the resilience building process. While CITY (in capital letters) concept is used in the Robust and VerTebrate maturity stages, where all the stakeholders are already involved in the resilience building process.

Table 1 shows the description of the relevant stakeholders considered in the SMR Project.

Table 1: List of relevant stakeholders in SMR Project

Stakeholder	Roles in building city resilience
Local government	Local government includes the different departments of the city council and it is considered as the institutional level closest to citizens. It provides a strategic

	planning vision to better prepare the city to respond to disaster risks and improves health, well-being and education. Furthermore, local government is responsible for ensuring the continuity of services in the city.
Regional government	A regional government is a government entity that has a control on a specific area that may include different cities.
National government	A national government is the political authority that controls a nation. The national government is responsible for maintaining security and stability and for establishing national laws and enforcing them.
European legislation bodies	The EU government is made up of the government of the EU Member States and it is the highest political authority in the EU. It is responsible for setting overall EU policy
Emergency services	The emergency services include entities that manage emergencies such as civil protection units and managers, as well as entities that are on the front line of emergencies such as police, firefighters, military forces and health care services. The role of these entities is to provide security and safety to citizens by reducing, preparing and responding to disaster risks.
Critical infrastructures providers	Critical infrastructures provide essential needs to the citizens such as health care, transportation, telecommunications, water, energy etc. Their adequate functioning in case of emergencies is crucial. This stakeholder also includes the Health Service, not only focused on emergencies.
Media	Media includes the local newspapers and radio and television channels. They play an important role disseminating hazard information and early warning measures in an easy to understand and accessible manner.
Academic and scientific entities	Academic and scientific entities include universities and research centers. They contribute to increasing the knowledge and the development of

	methodologies and technologies to better mitigate and prepare for, respond to, and recover from emergencies.
Public and private companies	Public and private companies include consultancies, insurance companies, and businesses. Many services depend on city structures, and thus companies need to be engaged in awareness raising and training programs so that they are able to prepare and respond to emergencies.
Citizens	Citizens play a vital role in initiating action by advocating for change and influencing decisions from the local government. Citizens need to be empowered to act responsibly in emergencies.
Volunteer organizations & NGOs	Volunteer organizations include youth organizations, churches, day centers, community emergency response organizations. These organizations may be funded by governments, business or private persons and provide support such as food and shelters. An NGO is an organization that is neither a part of a government nor a conventional for-profit business. Usually set up by ordinary citizens, NGOs can act as support or lobbying bodies, encouraging others to be prepared or plan ahead in case of emergencies.
International organizations	Apart from all levels of governances, nowadays there are international organizations committed to building resilience. These organizations lead and participate in research projects in order to achieve this objective. Examples of these organizations are the Rockefeller foundation and UNISDR, among others.

Achieving the involvement and collaboration among all the city stakeholders is needed for the resilience building process but at the same time this collaboration is an arduous task. All stakeholders' opinions should be considered what leads to conflict of interests among them that can hinder the achievement of consensus about decisions, investments and responsibilities. This is the case of public-private partnerships. The priority of governments at any level (local, regional, national and international) and public entities is watching over protection of citizens guaranteeing social welfare. However, the private sector is profit-oriented what influences the decision-making process prioritizing short-term profits

against long-term consequences. This fact may limit their commitment to close partnerships and agreements. This occurs with the climate change agreements where some private companies are reluctant to implement some policies that reduce their emissions if they impact their growth and profitability. However, despite their difficulty, public-private partnerships help communities become more resilient in the face of natural and man-made shocks and events in addition to increasing efficiency and effectiveness in the process.

4.2.3. POLICIES

Policies are defined as the actions or measures that cities should develop in order to achieve a maturity stage. Each maturity stage has defined a set of policies so that each CITY knows exactly what steps they should take to reach the objective of that stage. Actually, each maturity stage defines specific resilience building policies taking into consideration the descriptions and requirements of the maturity stages. Note that the implementation of these policies will allow the CITY to move forward from one stage onto the next, i.e. while the policies defined in one maturity stage are not completely developed CITIES cannot achieve that maturity stage. In addition, it should be highlighted that when the city progresses to the next stage, it does not mean that it has to forget about previous stages, but that it should at least maintain what it had already achieved.

These policies have been classified considering the following five resilience dimensions (see Figure 6):

1) **Leadership & Governance**: Leadership and Governance affect the decision-making process of the CITY. Commitment by the leaders to a resilience culture, values and vision is essential for promoting effective strategies, inclusive decision-making and the engagement of city relevant stakeholders. The governments at all levels should develop an organizational culture of enthusiasm for challenge, agility, flexibility, adaptive capacity and innovation.
   This dimension involves also the concept of multi-level governance that requires understanding the dynamic inter-relationship within and between different levels of governance and government. The transfer of competencies upwards to supra-national organizations and downwards to sub-national authorities has arguably transformed both the structure and capacity of national governments.
2) **Preparedness**: It refers to anticipation of future needs and adapting the CITY functions accordingly. Preparation can be developed at all levels of society, from individuals and

communities to leaders and governments. It also includes being prepared for the unexpected, by increasing flexibility and the CITY's adaptive capacity.

3) **Infrastructure & Resources:** The CITY infrastructure requires robustness to resist and absorb hazards through the preservation and restoration of its essential functions. This requires redundancy, risk management and continues work on decreasing vulnerabilities apart from the deployment of resources. The resources include all assets, people, skills, information, technology (including plant and equipment), premises, and supplies and information (whether electronic or not) that an organization needs to have available to use, when needed, to operate and meet its objectives.

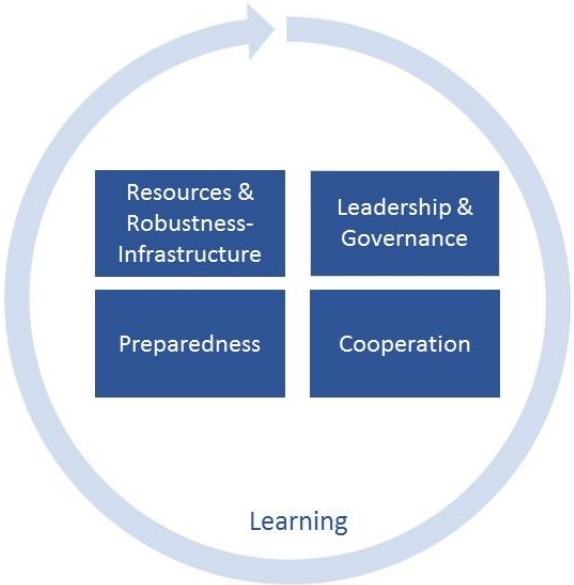

Figure 6: Dimensions used to classify the policies in the SMR Maturity Model

4) **Cooperation:** Cooperation means working or acting together for a common purpose or benefit. Cooperation is developed within the city and at a cross-regional level. The necessary stakeholders across city and regional sectors including European cities will be considered. Cooperation is also developed at community level involving different stakeholders such as volunteer groups and citizens that show the ability to self-organise.
5) **Learning:** Resilience development is a continuous learning process that consists of acquiring the ability to internalize past experiences that can led to adopt new solutions. The CITY stakeholders acquire knowledge, behaviour, skills, values, preferences or understanding of infrastructures, preparedness, leadership, and cooperation that help to improve the level of resilience of the city, optimize the use of resources and avoid repeating previous mistakes. Learning is achieved through monitoring of past events and on-going processes to make predictions about future needs. The CITY needs to develop a set of best practices, which can help to guide new knowledge and learning activities. Learning is acquired in each of the four dimensions mentioned previously, being a cross-dimensional and a continuous process. Leadership & Governance fosters the culture of resilience, formalize the learning process and

develop mechanisms to assess it. The reflection on past events, emergency drills and exercises allows to learn from previous mistakes improving the preparedness of city stakeholders to deal with future shocks and stresses and the reliability of infrastructures. Resources need to be allocated to fund research projects to innovate. Finally, the cooperation and collaboration among the city stakeholders and their participation in national and international networks in which they collaborate with other cities and stakeholders can foster the learning processes through the mutual sharing of best practices and knowledge.

5. PRELIMINARY VERSION OF THE SMR MATURITY MODEL

The SMR maturity model serves to identify the ideal path for the evolution of the resilience building process from an initial stage to a more advanced stage, passing through a number of intermediate stages, where cities have different starting points. The fulfilment of the policies included in each maturity stage will allow the city to move forward from one stage to the next one improving its resilience local level as well as enhancing the European resilience level.

The SMR maturity model classifies the policies in different maturity stages to guarantee the efficiency of the resilience building process, but it does not mean that this policy will start and be fully developed in the same maturity stage. At the same time, the policies developed in previous maturity stages must at least maintain what it has already achieved or further develop as the CITY makes progress in the maturity stages. Therefore, the SMR Maturity Model includes the concept of continuous improvement management process that allows including changes needed in the policies to adapt to new situations extending the well-known PDCA cycle[4] and the Integrated Management System developed in the CHAMP Project[5].

4 http://www.hse.gov.uk/managing/plan-do-check-act.htm

5 http://www.localmanagement.eu/index.php/cdp:home

The PDCA cycle (Figure 7) begins with the Plan step that involves identifying a goal or purpose and putting a plan into action. These activities are followed by the Do step, in which the components of the plan are implemented. Next comes the Check step, where outcomes are monitored to test the validity of the plan for signs of progress and success, or problems and areas for improvement. Finally, the Act step closes the cycle, integrating the knowledge and learning generated by the entire process, which can be used to adjust the goal. These four steps are repeated over and over as part of a never-ending cycle of continuous improvement.

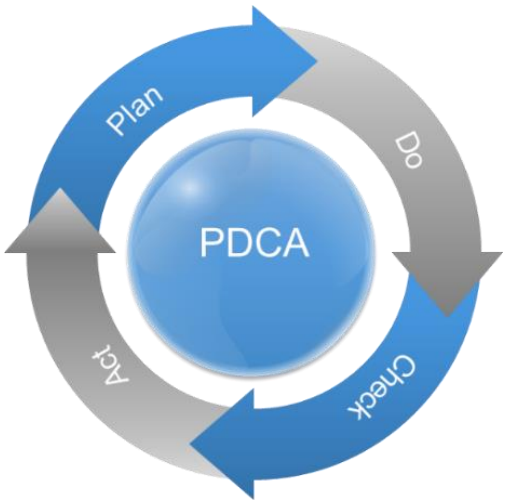

Figure 7: PCDA cycle

This continuous improvement management process is repeated in each of the maturity stages, keeping in mind two cross-cutting elements throughout the complete maturity path: the involvement of stakeholders and the quality improvement. Thus, the number of the stakeholder types (including external stakeholders from outside the city) involved in the resilience building process increases as cities progress in the maturity stages and, the learning the cities are acquiring during the different maturity stages leads to raising the effectiveness and quality of the measures adopted in the more advance maturity stages.

Figure 8 represents this iterative management process to build and improve the city resilience level throughout all maturity stages, where the X axis shows the increase in the number of the stakeholders involved in the resilience building process, while the Y axis shows the quality improvement over the maturity stages. The increase in the size of the PCDA cycles also shows an increase in the scope of the policies included in each maturity stage.

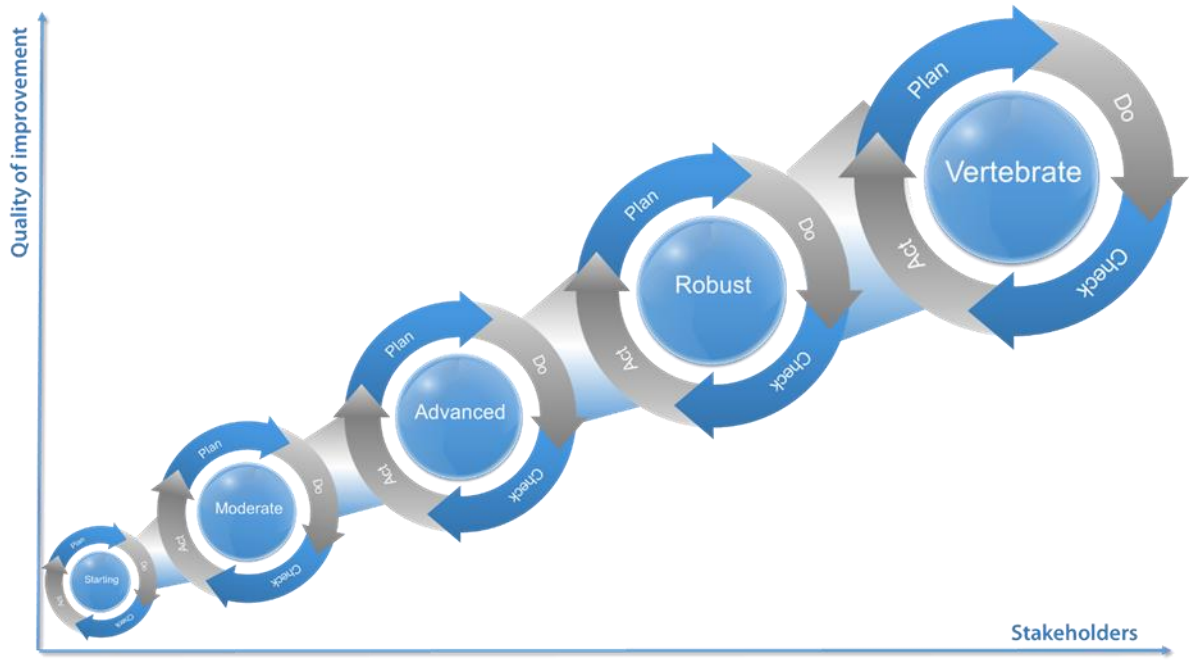

Figure 8: Iterative management process to build and improve the city resilience level throughout all maturity stages

The following sections describe each maturity stage explaining the stakeholders involved and the policies included in each stage. The whole SMR Maturity Model is presented in Annex 1.

It is important to note that the SMR Maturity Model is useful for those CITIES that have adopted a resilience approach to deal with shocks and stresses, since the first maturity stage has already included this approach although from a very initial stage. Therefore, those CITIES that are developing risk assessment without resilience approach and only react to the most urgent risk without assessment are considered to be in a stage previous to the first stage (Starting) described in the SMR Maturity Model.

5.1. Stage 1: Starting

5.1.1. DESCRIPTION

So far, the crisis management is based on risk assessment without having an integrated approach towards multi-hazard approach; therefore, any risk assessment is still fragmented and incomplete regarding hazards. Critical Infrastructure providers operate independently of each other, therefore there is a need for greater organisation and cooperation among the Critical Infrastructure providers, especially

in times of emergency when a disruption to one Critical Infrastructure can have cascading effects across other infrastructures. Measures to improve Critical Infrastructures' reliability and robustness are identified and start implementing.

Different city departments have started developing resilience policies however, there is no coordination between the different activities conducted by different departments. Having a common strategy among the municipal departments is still missing. Additionally, the relevant stakeholders and sectors outside the municipality work also independently from others.

In this context, the local government recognizes the need to develop an integrated resilience action plan with common practices and approaches, so that the resilience approach/strategy is included in the city's agenda at a strategic level. This way, the city makes the resilience strategy central to the Municipality Plan although the resilience action plan is still focused on dealing with shocks without considering chronic stresses.

The city has developed a risk assessment to anticipate failures and mitigate risks as an input for the resilience action plan. A risk register is used to evaluate impact and probability of individual risks, which helps to develop risk mitigation strategies for highest priority risks at city.

At the moment, the resilience action plan is limited within the city's borders. The local authority adopts a local governance approach, not recognizing yet the need for a multi-governance approach. As a consequence of this local governance approach, there is a lack of collaboration with sub urban or regional stakeholders. The participation of the local municipality in resilience networks is also incipient.

5.1.2. AGENTS INVOLVED

At the starting stage, the commitment of the local government to the city resilience building process is required to include the resilience approach in the city's agenda. At this stage, the different departments of the local government take actions and implement policies that contribute to improving the city resilience. However, these measures and policies are not coordinated and integrated into a common strategy. At this point, the **local government** acts proactively leading the resilience building process. Its role is crucial since it integrates the actions developed independently by different municipal departments and stakeholders into a common strategy and communicate it so that everybody involved in the process has the same understanding about its objectives.

Furthermore, at this stage emergency services and critical Infrastructure providers have agreements to collaborate with the local government to guarantee the provision of basic services as well as an adequate response in case of emergencies. Nevertheless, collaboration among critical service providers and emergency services need to be improved as these services operate independently. At this point, the role of Critical Infrastructure providers is reactive to accomplish the local government and emergency services requests, conducting joint emergency drills to meet minimum mandatory requirements.

5.1.3. POLICIES

The different polices or actions that each city needs to take into account in this stage are the following ones:

Dimension	Policy
Leadership & Governance	**1. Integrate resilience into new visions, policies and strategies for city development plans** The city starts to consider resilience as central part to ist agenda, and takes upon the decision to involve resilience building activities in development and planning procedures. **2. Establish a working team responsible for resilience issues in the city** The city establishes and sets into action a team that will mainly focus on resilience building efforts, from initial assessment to specific interventions and projects that strengthen resilience **3. Develop short term city plan (challenges, statistics, geographic areas) that give measures and financial measures** The local government develops a city plan with some objectives to meet in the short term that will include planning for urban resilience and measures to deal with climate change, social problems and Critical Infrastructure dependencies and cascading effects. **4. Communicate information on risks and protection measures widely to stakeholders so that they can react appropriately**

	This policy consists of sharing the information that the city has about the risks and protection measures to the stakeholders involved at this stage in order to response effectively when a crisis occurs.
Preparedness	**5. Develop a preliminary resilience action plan to respond to shocks** The city aims to establish a systematic approach to building resilience in crisis, notably by supporting populations at risk to withstand, cope with, adapt and quickly recover from shocks with a focus on efficient interventions having a lasting impact. 6. **Create a simple Risk Register which is used to evaluate proposed policies on the individual basis. This involves generation of a list of risks mainly focused on sudden shocks, and assessment of their impact and probability.** This refers to the creation of a traditional Risk Register which lists risks the city faces. Policies being considered by a city will then be evaluated with respect to these risks on an individual basis. The assessment of impact and probability can include both quantitative and qualitative approaches. **7. Establish priorities based on risk assessment of potential events at the city/regional level (probability x impact).** The risks identified in Risk Register are prioritized with regards to their significance for the city. This is important because it helps the city better understand how to allocate its resources and how to organize its preparation for addressing those risks. 8. **Develop mitigation strategies for the individual risks**. Risk are considered on an individual basis when deciding upon mitigation actions. **9. Make a list of priorities for essential services and core resources (identify essentials and non-essentials)**

	This policy is about prioritizing among conflictive goals to assess the most important values/assets to protect. **10. Develop a diagnosis and assessment of the city's vulnerabilities, risks and strengths** This policy is about studying city's vulnerabilities, risks and strengths in order to respond effectively when a crisis occurs. **11. Update existing plans and response mechanism guidelines for emergency situations** This policy means to have an updated database and guidelines of the existing plans and response mechanisms in order to know what to do in an emergency situation **12. Conduct training and arrange emergency drills and exercises with the emergency teams** Training activities with the emergency teams need to be carried out in order to be prepared and response quickly when a crisis occurs.
Infrastructure & Robustness	**13. Develop cooperation/collaboration agreements with critical infrastructures for ensuring the continuity of critical services in case of crisis or emergency.** The local government establishes collaboration agreements with critical infrastructures of the city to help and collaborate with them in emergency situations in order to ensure the delivery of critical services in the city. **14. Develop measures to increase Critical Infrastructure redundancy and reliability** At this stage, Critical Infrastructures are required to identify at least actions that ensure their redundancy and reliability in terms of providing critical services in case of emergency situations. The implementation of these actions could start in this first stage or can be part of the following maturity stages, depending on the context of the city (resources deployed, commitment of the stakeholders…)

	15. Develop periodical maintenance procedures to guarantee the correct level of performance of critical infrastructures. Critical infrastructures are required to carry out maintenance actions with a regular periodicity. The objective of these maintenance actions is to guarantee the correct level of critical infrastructures and that they are able to provide critical services in emergency situations. **16. Develop a list of the current resources available** At this stage, the local government makes an exhaustive analysis of the critical infrastructures and services, resources, assets of the city, etc. This information is necessary to take into account in the resilience action plan.
Cooperation	**17. Map and bring together relevant stakeholders** The policy means that the city delineates the existing resources, relevant entities in different sectors of the city, as well as public and private companies that provide vital services for the city. This can include identifying stakeholders that do not yet exist in current structures but will be necessary in the future. The stakeholders can also be interest groups in the community, NGOs and media. **18. Develop/Create a common understanding of resilience among different stakeholders** The city should find ways to build common understanding, being aligned and being in the "same page" between stakeholders when come to resilience. It can be achieved through for example, regular meetings, developing guidelines and common vocabularies or terminologies. **19. Develop a public website with updated emergency information and communicate advice and support to citizens during any shock events**

	In this phase, information is provided in one way (local government to citizens). A public website does not have interactive communicating functions. **20. Establish small collaborative groups within a city (district, neighborhood) on specific in smart city topics** A small working group related to a specific topic is established.
Learning	**21. Establish and maintain a database of past shocks and current risks for learning purposes** The goals are to have an overview of the past incidents including facts and measured data and to generate assumptions on the risk of future incidents **22. Develop a strategy to create a resilience culture, learning from experience and integrating city departments and stakeholders** The strategy should foster the resilience culture in a city among citizen's agencies. It should also focus on a culture of knowledge and respect of the different by learning from experience and integrating city departments and stakeholders.

5.2. Stage 2: Moderate

5.2.1. DESCRIPTION

The risk assessment with regard to hazards affecting Critical Infrastructures is operationalized in cooperation with Critical Infrastructure providers in order to deliver essential services in case of crisis or emergency, defining measures to rapidly bounce back maintaining the previous level of functioning.

The resilience action plan includes policies to be prepared and respond to shocks and chronic stresses using a holistic approach.

At this stage, the city uses a more holistic approach to risk assessment through using the risk register to reflect on interdependencies between risks. It means identifying 'potent' risk policies that can manage

a number of risks in a risk area and focusing on allowing the city to pay attention to 'bouncing back' from both shocks and stresses.

The city sets up the organizational structure to manage the resilience action plan and deploys resources for its development. The city starts monitoring the implementation of the policies included in the resilience action plan using control measures, although there is a lack of a formalized resilience management process.

A communication strategy that will scale up resilience building efforts is set up. The city carries out initiatives such as events and training activities to increase the awareness level of the different stakeholders to foster a resilience culture among them.

The city starts the development of a multi-governance approach defining accordingly a strategy to strengthen this approach.

Regarding collaboration, the city recognizes the importance of networks and platforms for engagement of stakeholders and knowledge sharing. At this point, the platform is internal to the municipality and emergency services. Moreover, the city has started planning for networking with other cities at regional level with regard to resilience and sustainability.

5.2.2. AGENTS INVOLVED

At moderate stage, Critical Infrastructures and emergency services collaborate on a regular basis with the local government The local government's commitment has fostered the achievement of partnerships between Critical Infrastructure providers and emergency services to conduct joint training exercises regularly. The interdependencies from the different critical services are integrated and included into a common long-term resilience plan of the city. Furthermore, at this stage, volunteers and NGOs are involved in training programs and emergency exercises with emergency services and Critical Infrastructures. Local government is a key driver in this process informing citizens about the volunteering opportunities and supporting them. In addition, the regional government starts to be involved in the resilience building process and collaborates with the local government in the development of the city resilience action plan. Finally, initial efforts are undertaken by the local government to involve public and private companies in the resilience building efforts.

The local government is aware of the importance of creating public-private partnerships to help communities become more resilient in addition to increasing the efficiency and effectiveness of the

resilience building process. Consequently, the local government communicates the resilience strategy to public and private companies asking them for their commitment and active involvement.

5.2.3. POLICIES

The different polices or actions that each city needs to take into account in this stage are the following ones:

Dimension	Policy
Leadership & Governance	**23. Establish a resilience department or committee to steer and coordinate the city's resilience action plan and a cross departmental coordination board - Institutionalize the resilience action plan by developing a new organizational structure in the municipality, including the CRO position alongside other supporting roles** Moving away from just planning, the city allocates resources into a resilience action plan and a department that will deal specifically with resilience building efforts- **24. Establish a committee responsible for monitoring the implementation of the resilience building plan, coordinating the actions across the different stakeholders and raising any new challenges** The city will establish and assign responsibilities to a committee that will monitor and implement the resilience building plan, trying to involve all relevant stakeholders and assign them to specific working groups **25. Develop procedures for cross departmental coordination assigning responsibilities, duties and resources regarding the resilience action plan** The city needs to identify and coordinate the responsibilities, duties and resources about the resilience action plan **26. Develop a white paper about multigovernance approach that aims at integrating the EU dimension**

	The city develops a white paper to integrate mechanisms developing long-term strategic plans and involving all levels of governance, reinforcing its democratic dimension and following EU standards and regulations **27. Align, integrate and connect the resilience action plan with regional plans** The city has an overview of all existing local and regional plans and develops a white paper that suggests and defines the involvement of the different levels of governance, plus the EU dimension on resilience. Also, it incorporates the resilience approach in all plans and makes it central to its agenda. **28. Develop a communication strategy to inform the stakeholders about the targets and goals of the resilience action plan highlighting co-benefits** The city needs to establish a communication source to inform the stakeholders involved in this stage about the resilience actions plan highlighting co benefits in order to increase resilience awareness
Preparedness	**29. Develop a resilience action plan to respond to shocks and stresses using a holistic approach** The city aims to establish a systematic and holistic approach to building resilience in crisis and risk-prone contexts, notably by supporting populations at risk to withstand, cope with, adapt and quickly recover from stresses and shocks without compromising long-term development prospects, with a focus on efficient interventions having a lasting impact. **30. Extend use of Risk Register to identify long term chronic stresses for the city/region and reflect on the interdependence between risks.**

The use of the Risk Register is extended to consider chronic stresses on the city and its region in addition to considering how risks impact (and potentially reinforce) one another.

31. **Prioritize risks with respect to both sudden shocks and long term chronic stress scenarios (networks of risks).**

    At this stage, in terms of risk prioritization, a clear distinction is made between the sudden shocks and chronic stresses. This adds further complexity to the risk prioritization, but it allows to prioritize risks in a more refined way.

32. **Develop mitigation policies/strategies with respect to high risk areas. This involves identifying potent policies/strategies that can 'hit' many risks within the risk areas.**

    The interdependence of risks is taken into account when considering mitigation policies. The policies that are chosen are those which will have an impact on a number of risks.

33. **Develop/Establish leading indicators to assess and monitor resilience action plan**

    It is necessary to identify and use indicators in order to know the level of implementation of the resilience action plan.

34. **Review best practices used in different sectors that relate to the resilience action plan**

    This policy has to with learning from other cities' experiences to assess own vulnerabilities and response capacity.

35. **Identify key assets (strengths) relevant to cope with known variations and disturbances. This includes and analysis of enabling factors for each asset.**

    The city needs to know its strengths in order to response to variations and disturbances.

36. **Set up early warning, monitoring systems to alert for potential arising risks**

	The city needs to establish warning and monitoring systems in order to know if a potential risks is coming. **37. Develop clear procedures to collect, classify and share data to comply with legal implications.** The city needs to elaborate procedures to collect and share the data about resilience. The procedures should include information about what data must be collected for, how to store and use it to ensure systems continue working during a shock or stress. **38. Provide training to the volunteers** Training activities are carried out with volunteers in order to response quickly when a crisis/shock occurs **39. Promoting a culture of resilience organizing resilience awareness activities such as campaigns, events and training activities for all the stakeholder** It is very important to increase resilience awareness among the stakeholders. To do that, different activities should be arranged such as events or training activities.
Infrastructure & Robustness	**40. Develop internal audits to ensure critical infrastructures have emergency plans and comply with rules and legislation to deliver essential services in case of crisis or emergency.** The local governments require that Critical Infrastructures conduct periodic audits to ensure that they comply with rules and legislation **41. Develop a contingency plan aimed at keeping CI functioning at minimal level in case of crisis or emergency** The local governments have emergency contingency plans to deliver critical services in case of emergency situations. **42. Integrate the resilience action plan into the local government budget to increase the resilience of the city**

	At this stage, the costs and resources assigned to the implementation of the resilience action plan of the city are included in the local budget of the local government. **43. Deploy a disaster relief fund for emergencies** At this stage, the local government allocates funding to provide resources and help city stakeholders in emergency situations and increase the resilience of the city.
Cooperation	**44. Develop a stakeholder engagement plan to structure their interaction (with a clear definition of their roles and responsibilities) increasing the awareness of stakeholders on resilience action plan** The policy means that the city starts developing a systematic plan on how to engage and interact between stakeholders previously identified. The city has a clear definition of their roles and responsibilities and a systematic plan such as awareness program for socializing and increasing awareness of the stakeholders of the city's resilience action plan **45. Develop an internal website/communication platform that offers secure online space for sharing information with different municipal departments and emergency services** The policy consists of setting up a website that facilitates the internal communication via secure online platform among stakeholders **46. Collaborate/Establish alliances among cities with similar risks to strengthen the collaboration** Cities start to look for opportunities for further cooperation with other cities to enhance city resilience.

	47. Scout and assess current initiatives, projects and funding opportunities such as EU-Projects/Programs to eventually join alliances Cities start to look for opportunities for further funding or cooperation with other cities to enhance city resilience.
Learning	**48. Analysis of lessons learned from past emergencies internally with the different entities of the emergency services.** All involved parties are to get together on one table and to revise past actions of emergency cases.

5.3. Stage 3: Advanced

5.3.1. DESCRIPTION

The city has developed an operational resilience action plan with holistic approach that integrates all sectors and relevant stakeholders. The resilience action plan contains measures to increase the flexibility of city infrastructures to deal with shocks and stresses and to adapt to on-going circumstances.

The resilience action plan implements a risk assessment that includes measures to rapidly bounce back (maintaining the previous level of functioning) and 'bounce forward' (taking opportunities as they come along to thrive under change).

The progress of the resilience action plan is monitored using leading and lagging indicators in order to assess the effectiveness and impact of the implemented policies.

The resilience action plan is continuously revised based on the non-compliances identified and improved including lessons learned and best practices obtained through institutionalizing regular debriefing sessions to facilitate a shared understanding, reflection and discussion.

Fostering community resilience and public & private cooperation is part of the resilience approach. The city recognizes that in order to increase the engagement and mobilization of relevant stakeholders there is a need for a shift from top-down city level to bottom-up initiatives. Promoting incentives for citizens

and private sector to provide with solutions they can implement at local level helps strengthening social cohesion and support the goals of the resilience action plan.

The municipality changes its role, becoming a facilitator instead of having a central guiding policy role.

The multi-governance approach with a European dimension is included in the plans, but not yet fully operationalized.

The city is member of a major network of European cities with regard to resilience and sustainability.

5.3.2. AGENTS INVOLVED

At the advanced stage, local and regional governments, emergency services, critical infrastructures and public and private partnerships are engaged in learning networks to improve the city resilience action plan. Furthermore, the contribution of academic and scientific is recognized at this stage, where partnerships are developed to identify methodologies to improve and evaluate the progress of the city resilience. The research carried out by academic and scientific entities is of paramount importance in the development of new concepts and approaches and in the assessment of their relevance in the resilience-building process. The local government provides incentives for investments in R&D&I projects to test innovative ideas, methodologies and tools that address the challenges of the resilience building process.

In addition, to improve collaboration with public and private companies, these companies are provided with incentives if they contribute to the achievement of goals of the city resilience action plan. Also, the media is involved in the city resilience building process and information is shared with them so that the goals and actions of the resilience action plan are widely informed to citizens. Media is used by the local government as a channel to communicate and disseminate to citizens the municipality strategy towards building resilience, increasing citizens' awareness and commitment to contributing in the resilience building process.

At this stage, citizens are also provided with the opportunity to participate in platforms to provide input, suggestions and comments about the resilience building process. Moreover, direct citizen involvement is a strategic shift in resilience building process. Citizens contribute to increasing the preparedness, response, and recovery of shocks and stresses since they are usually the first responders, already at the scene of a disaster as it occurs demonstrating a capability to deal with the emergency situation.

Programs designed at any governance level to inform citizens about the specific risks in their local environment and providing tips on how to prepare for and react to these risks increase their awareness and preparation capacity to take appropriate actions if something occurs.

Finally, the national government is also involved in the resilience building process of the city to integrate and connect the city resilience action plan with national plans.

5.3.3. POLICIES

The different polices or actions that each city needs to take into account in this stage are the following ones:

Dimension	Policy
Leadership & Governance	**49. Support citizens and private sector initiatives that contribute to build resilience at local level (grants)** The city provides with general support to bottom-up initiatives that have been active in sectors related to resilience. This support can be financial, promotional, provision with volunteers etc. **50. Develop a plan for multigovernance approach involving the municipal, regional and national levels of governance** The city develops a plan with mechanisms to involve municipal, regional and national levels of governance. **51. Align, integrate and connect the resilience action plan with national plans** The city will need to adopt urban planning and building design strategies that allow them to increase their abilities to better respond and adapt to the economic, social, and physical challenges by involving all levels of governance and connecting each strategy to national plans **52. Develop a legislative framework identifying obligations and constraints to ensure the implementation of resilience action plan** The city defines a legislative framework that includes the obligations and responsibilities of the different stakeholders in the resilience building

	process. This legislative framework will allow to incentive or penalized the stakeholders when they do not meet these obligations. **53. Communication of the resilience action plan to the citizens** Development of a detailed communication strategy, prioritization of activities, allocation of responsibilities among the responsible partners/departments etc.
Preparedness	**54. Refine the Risk Register with respect to the risks experienced in the city/region.** Risk Register is now updated regularly based on shocks and stresses experienced by the city and region. **55. Assess risk scenarios which involves exploration of possible long term ramifications of risks and their cascading effects. Use of Risk Systemicity Questionnaire for policy analysis.** In comparison with the use of Risk Register, Risk Systemicity Questionnaire entails a stronger focus on the interdependencies between risks which are central to the tool. At this stage the city starts using the Risk Systemicity Questionnaire to, for example, better understand the risks which can affect it, and the policies which it may need to implement to address those possible risk events. An important point of focus are the cascading effects, long term ramifications, and unintended consequences of the introduced policies. **56. Monitor key risks (through an evaluation of developing risk scenarios) and coordinate policies/strategies for targeting high risk areas with relevant stakeholders at the city/regional level.** Continually reassess those risks that need attention through monitoring risk scenarios and coordinate appropriate policies to mitigate the risks through the involvement of multiple stakeholders. **57. Implement centralized control of coordination of critical resources and activities to make resources accessible to local initiatives during a crisis.**

	The city needs to control in a centralized way the coordination's of resources and activities during a crisis **58. Conduct frequent joint training exercises with CITY's relevant stakeholders to ensure their efficient collaboration** This policy is about carrying out training activities with the stakeholders involved in this stage in order to response quickly when a crisis/shock occurs **59. Develop education programs in schools explaining the goals and actions of the resilience action plan** The collaboration with schools in order to increase citizens' awareness about resilience and their preparation to deal with future emergency situations. **60. Train local organizations and individuals to make use of local resources during crisis** This policy is about carrying out training activities with the local organizations in order to response quickly when a crisis/shock occurs **61. Encourage companies to have appropriate insurance coverage and develop business resilience plans** This policy tries to alert companies about the importance of having an appropriate insurance coverage and resilience business plans
Infrastructure & Robustness	**62. Develop measures to increase the flexibility** Flexibility is an essential part of resilience. By learning how to be more adaptable, infrastructures will be better prepared to respond to adversity. Resilient infrastructures and organizations often use difficult events as an opportunity to branch out in new directions. While some may be crushed by abrupt changes, those who are highly resilient are able to adapt and thrive.

	63. Integrate resilience with urban planning to understand future resilience requirements and identify infrastructure projects. At this stage, the plans and projects from the local government to construct buildings, infrastructures, and urban areas are aligned with the requirements and recommendations of the resilience action plan of the city **64. Relocate housing programs to move households and companies out of hazard areas and into safe locations, and remove existing damaging infrastructure** In order to reduce city's vulnerabilities, it is necessary to develop programs to move houses or companies out of hazard areas and to remove damaging infrastructure.
Cooperation	**65. Develop a communication platform/website that allows the interaction between the municipality and other stakeholders to provide input, suggestions and comments about the resilience building process** Bidirectional information flow takes place between the local government and the rest of the stakeholders. **66. Join a major Network of EU cities** As starting point of further cooperation, cities become a member of resilient cities network. **67. Develop partnerships (like research projects) with academic and scientific entities that contribute to the development and understanding of the resilience building process in the CITY.** Cities can get objective evaluation of what they are doing by collaborating together with academic and scientific partners.
Learning	**68. Integrate lessons learned from past emergencies in resilience action plan** Develop solutions for problems learned from the past

69. **Share best practices with other municipalities**

    The goal is to exchange experiences on past incidents and identified risks

70. **Formalize the learning process, institutionalizing regular debriefing meetings**

    The learning process should be described and regular debriefing meetings between the stakeholders engaged in this stage should be initiated.

71. **Establish learning partnerships in the context of risk mitigation with relevant stakeholders at the regional/city level.**

    Develop alliances with the stakeholders involved in this stage to learn about risk mitigation

5.4. Stage 4: Robust

5.4.1. DESCRIPTION

All relevant stakeholders to be involved in the resilience action plan have been identified and engaged the majority of them, so in this stage we can speak of a CITY. Stakeholders are proactive and perceive value added by resilience on their quality of life and economy. They are also aware that the resilience approach is a never ending process where the CITY is always in a 'perpetual beta' mode. Resilience is part of daily thinking and acting.

The resilience action plan is monitored and assessed based on regularly collected information and the successes and possible draw-backs of the process are reported, giving feedback for the resilience action plan revision process. The focus will be on making system and community resilient and not place sole responsibility on the individual employee and citizen. The resilience action plan is continuously improved and updated based on the feedback and suggestions received from the city stakeholders through consultation processes and participatory platforms.

The CITY is capable of 'bouncing back', 'bouncing forward', and ensuring protection from shocks and stresses.

The CITY must work with direct democracy including local decision-making power within a given framework. The CITY administration and organization is flexible to adapt and evolve as the threat landscape continuously shifts. Local communities can work as self-organized systems that can deal with the uncertain situations.

The multi-governance approach with a global dimension is well developed and operationalized.

The CITY is participating in a variety of important networks with regard to resilience and sustainability, with a proactive posture and continuous learning, transferring knowledge and best practices to be prepared for any unknown events.

5.4.2. AGENTS INVOLVED

At robust stage, the European legislative body is involved in the city resilience building process. This enables to have a common legislative framework with guidelines for the collaboration among different countries and the resource sharing in case of shocks and stresses. The European legislative body also provides guidelines to help infrastructure providers to incorporate resilience building programs towards climate change, shocks and stresses apart from the policies to overcome inequalities and promote well-being and cohesion.

Additionally, the city is engaged in a variety of European networks to collaborate with other European cities. Therefore, at this stage all the city stakeholders (local, regional, national and European government, emergency services, critical infrastructures, public-private companies, NGOs, Volunteers, Regional government, media, citizens, academic and scientific entities) are actively involved in the development of the city resilience. Furthermore, the feedback and opinion from these stakeholders are taken into account for the implementation of the resilience action plan and to make decisions about the progress of the city's resilience. At this stage, stakeholders recognize the importance of collaborating in the resilience building process and perceive the benefits. Also, they make effort to learn and improve the resilience development by sharing lessons learned and engaging in multi-stakeholder discussions.

5.4.3. POLICIES

The different polices or actions that each city needs to take into account in this stage are the following ones:

Dimension	Policy
Leadership & Governance	**72. Operationalize the multi-governance approach with EU dimension** The city develops long-term strategic plans and involving all levels of governance, reinforcing its democratic dimension and following EU standards and regulations **73. Align, integrate and connect the city resilience plan with regional, national and international resilience management guidelines** The CITY performs a cohesive and integrated planning approach regarding resilience that involves all relevant stakeholders and aligns processes and actions with management guidelines from all governance levels **74. Coordinate with national and international authorities to apply and adapt policies and legislation to municipality action plan** The city involved all levels of governance, including the EU to work on improving policies and legislations
Preparedness	**75. Refine Risk Register with respect to the risks experienced in the city/region AND in Europe. Use of Risk Register to evaluate proposed policies AND to identify long term risks, and their interdependence, for the city/region/Europe.** The use and regular refinement of Risk Register is now extended to the European level, which involves working with European partners in the context of risk evaluation, the impact risks may have on one another and the evaluation of policies. **76. Evaluate regularly (twice yearly) overall evaluation of risk scenarios facing the city.** The Risk Systemicity Questionnaire is now used to regularly (twice per year) evaluate risk scenarios, as opposed to individual risks, which are likely to occur in the city.

77. **Prioritize risks extended to the European level. Appropriate cost-benefit analyses undertaken which informs the prioritization of risks.**

    The prioritization of risks is now conducted also on the European level, rather than only at the city/regional level. The process of prioritizing which risks to focus a city's resources on is informed by a cost-benefit analysis.

78. **Coordinate policies/strategies for targeting high risk areas with relevant stakeholders at the city/regional and European level and are informed by the European perspective.**

    The coordination of policies extends to the involvement of stakeholders at the European level and are informed by taking account of experiences from Europe.

79. **Identify and train organizational abilities to re-structure and adapt in response to a variety of anticipated threat scenarios**

    This policy is focused on collaboration-training for different organizational bodies in the city with a focus on flexibility, authority, responsibilities, and communication and role-taking.

80. **Provide training courses for citizens and companies based on their specific needs and conduct frequently public drills at national level**

    This policy is about carrying out training activities for citizens and companies taking into account their specific needs in order to response quickly when a crisis/shock occurs. Public drills at national level are carried out to improve the preparation and response.

81. **Arrange public debriefing sessions to facilitate a shared understanding, reflection and discussion on the resilience building process with stakeholders outside the municipality**

    This policy tries to increase stakeholder's resilience awareness and understanding through public debriefing sessions.

82. **Encourage citizens to have appropriate insurance coverage and develop household resilience plans**

	This policy tries to alert citizens about the importance of having an appropriate insurance coverage and household resilience plans. **83. Identify and train organizational abilities to re-structure and adapt in response to a variety of anticipated threat scenarios** This policy is focused on collaboration-training for different organizational bodies in the CITY with a focus on flexibility, authority, responsibilities, communication and role-taking
Infrastructure & Robustness	**84. Provide incentives for public and private sectors that invest in measures that increase the resilience and penalties to those who increase the risk and vulnerabilities** At this stage, the local government gives rewards, grants or incentives to companies and organizations both from the public and private sector that are committed to improve their resilience level. On the contrary, companies and organizations that reduce the city resilience are penalized. **85. Develop a methodology and action plan to enhance the quality of our welfare services without increasing in public spending** The city needs an action plan to improve the quality of the welfare services without increasing public spending
Cooperation	**86. Establish cross disciplinary collaboration to foster long term planning** This policy means that the city needs to encourage the stakeholders to cooperate beyond each organizational boundaries and domain, whenever it is relevant to improve long term planning. **87. Enable public platforms (i.e. databases) to enhance the sharing of resilience lessons learned and best practices among city stakeholders.** A website intended for public that facilitates learning and sharing information is set up.

	88. Undertake public consultations for the development and design of resilience actions-plans to support their implementation and receive continuous feedback by citizens and stakeholders. Interactive communication turns to be a driver of coevolution of each stakeholders' activities towards building resilience. **89. Widen collaborative networks with representatives from the emergency services, critical infrastructures, public and private companies, academic entities, media, citizens, and volunteer organizations to ensure the performance of duties, to reflect on and make decisions about the progress of the city's resilience.** Collaboration among various stakeholders' including citizens takes place. **90. Become active in a major network of EU cities to promote initiatives, exchange experiences and increase cooperation** Cooperation boundary tends to expand to EU and global cities. **91. Proactive participation in regional, national and international networks to promote initiatives, exchange experiences and increase cooperation with continuous learning** Cities can bring their experience to these networks as lessons they should learn.
Learning	**92. Create a Learning city: to work in partnership to create and promote learning opportunities (all ages, all parts of city)** This policy means to work in partnership to create and promote learning opportunities (all ages, all parts of city) **93. Arrange multi-stakeholder debriefing sessions to facilitate a shared understanding, reflection and discussion on the resilience building process to guarantee continuous learning** This policy tries to increase stakeholder's resilience awareness and understanding through public debriefing sessions

94. **Establish multi-stakeholder debriefing meetings with representatives for the city stakeholders to evaluate and improve the city's resilience plan based on lessons learned and past events**.

    The city evaluates with the stakeholders the resilience action plan analyzing lessons learns and pass events

95. **Establish learning partnerships in the context of risk mitigation with relevant stakeholders at the regional/city, National AND European level. Learning from effectiveness of risk assessment and mitigation.**

    Develop alliances with the relevant stakeholders involved in this stage to learn about risk mitigation

5.5. Stage 5: Vertebrate

5.5.1. DESCRIPTION

The CITY excels regarding its resilience as part of the regional, national and global system resilience, understanding that in order to become resilient the environment needs to be resilient as well. At this stage, the CITY is active both nationally and globally to spread resilient and sustainable initiatives. Actually, the CITY acts as a vertebra in the European resilience backbone and has an internalized resilience culture.

The resilience action plan is continuously improved based on lessons learned from past events.

There is a full integration of all known stakeholders in the resilience action plan, with a high level of participation of these stakeholders in the decision-making process. Communities are able to self-organize in order to help in case a crisis occurs.

The CITY acts as a leader in global networks and participates in the definition of resilience standards. Actions implemented in the CITY are presented to third parties as best practices.

The CITY is proactive supporting the development of resilience in other CITIES and regions as it understands the coexisting in a more resilient environment makes the CITY more resilient.

5.5.2. AGENTS INVOLVED

At vertebrate stage, all the efforts from the city stakeholders (local, regional, national and European government, emergency services, critical infrastructures, public-private companies, NGOs, Volunteers, Regional government, media, citizens, academic and scientific entities) are coordinated, integrated and aligned with the city resilience action plan. Furthermore, all these stakeholders are regularly engaged in debriefing meetings and experiences and lessons learned from these stakeholders are a useful input for improving the city resilience action plan.

Partnerships with international organizations such as the Rockefeller foundation and UNISDR (The United Nations Office for Disaster Risk Reduction), which lead and participate in research projects related to the improvement of resilience in different topics, can provide the CITY with the opportunity of networking with other cities and share knowledge and experiences.

5.5.3. POLICIES

The different polices or actions that each city needs to take into account in this stage are the following ones:

Dimension	Policy
Leadership & Governance	**96. Active participation in a network to share lessons learned and best practices with other EU cities (or more networks)** Cities and stakeholders develop formal lessons learnt that can be used by others to improve their resilience building process **97. Self organization of the cooperation between public and private agents for the development of Resilience in the CITY** The CITY encourages the cooperation among public and private institutions for the development of resilience; and these partnerships are able to self-organize **98. Embedment of Resilience standards and guidelines in every plan or policy that the CITY implements**

	The CITY takes into account resilience aspects whenever a decision is made. All the decision makers in the CITY are trained so they can take into account these aspects **99. Encouragement to proactive participation of Citizens in the Resilience development process** They CITY establishes procedures and tools so the citizens can also take part in the resilience building process. Citizens can take part in the design and implementation process, and are also permanently informed about it. **100. Encouragement to all the involved agents, including citizens, to provide feedback about the resilience development plans and policies** They CITY establishes procedures and tools so the citizens can also provide feedback about the resilience building process **101. Leadership of resilience projects (EU funded projects or other joint initiatives)** The CITY plays a leading role in the consortium it takes part, such as research projects
Preparedness	102. **Development of formal procedures to monitor risk mitigation strategy/policy implementation and impact**. Formal procedures are developed to evaluate value for money, which is also valuable to make the prioritization of risks. **103. Develop the Risk Systemicity Questionnaire into a Policy testing simulation model. This can be used to monitor and re-focus mitigation actions if necessary.** A dynamic simulation model is used to understand the behaviour over time of the impact of different policies on the city/region and European level.

104. Evaluate value for money which informs the prioritisation of risks.

The process of prioritization goes beyond cost-benefit analysis and considers value for money.

105. Assessment of the efficiency of training activities

Formal procedures are established to assess the efficiency of training activities

106. Permanent refinement of training programs based on assessment.

There is a continuous improvement process so the training activities are refined based on their effectiveness (or lack of effectiveness)

107. Development of training plans in cooperation with other CITIES.

The training plans and activities are not developed taking only into account local agents; but also including other relevant agents from the European resilience backbone

108. Active submission of training materials to other CITIES

The CITY designs and develops materials that can be used by other CITIES for training purposes

109. Development of training activities for other CITIES

The CITY leads the implementation of training activities for other CITIES which are interested in developing their resilience

110. Assessment of the value added by its contributions to the Resilience of other cities

The CITY develops assessment procedures and indicators that estimate which has been its contribution to the development of the resilience in other CITIES.

	111. Conduct frequent joint training exercises between European cities with the involvement of all the stakeholders included in this stage (international level) The CITY leads the implementation of training exercises where all the relevant stakeholders from the European resilience backbone take part. **112. The CITY monitors that the insurance level of citizens and companies is the suitable one.** The CITY knows the status of the insurance level of citizens and companies **113. Self-organization of Involved agents to improve the development of the Resilience of the CITY.** The public and private agents, including citizens, who can contribute to the development of the Resilience of the CITY have the capacities to self-organize **114. Encouragement of Involved agents to present their experiences concerning Resilience development as a reference for agents from other CITIES** The CITY encourages relevant local stakeholder to act as a reference for others **115. Development as a reference for agents from other CITIES** The CITY presents itself as a reference for agents from other CITIES, disseminating obtained results and making publicly available the used methodologies.
Infrastructure & Robustness	**116. Integration of CITY Infrastructures as components of a wider network** The infrastructures of the CITY constitute a network so they can interact with each other and establish cooperation mechanisms. **117. Integration of the plans to increase the Resilience of the Infrastructures and refined understanding these Infrastructures as components of a wider network**

	The infrastructures of the CITY develop their policies and plans concerning Resilience taking into account their interdependencies and synergies, concerning not only the infrastructures of the same CITY but also the ones in other places of the European resilience backbone. **118. Establishment of the Redundancy level of the Infrastructure of the CITY according to efficiency criteria** The infrastructures of the CITY have developed formal procedures to estimate which is the most adequate redundancy level, and they continuously improve their estimation based on new data **119. Establishment of a strong network of volunteers which is able to self-organize** As a result of this policy a strong network of volunteers that can be activated for the prevention, preparation, response and recovery has been established in the city. This network has the capacities to self-organize. **120. Refinement of resilience policies to take advantage of any shock and stress to bounce forward and improve or re-design.** The CITY understands that shocks and stresses can also be observed as opportunities and consequently the objective after a crisis is not just to come back to the previous state; but to improve the design of the CITY so it reaches a better status. **121. Refinement of the budget for Resilience so it is taken into account whenever the overall budget of the city is discussed.** Criteria concerning Resilience are included in all the CITY's decision-making processes.
Cooperation	**122. Self-organization of the cooperation among all the agents involved in the Resilience development.** The agents involved in the Resilience development have the capacities to self-organize

	123. Active involvement in networks to share lessons learned and best practices The CITY plays a proactive role in the networks it takes part, sharing with other CITIES lessons learnt and best practices. **124. Facilitation of other cities through the process of developing resilience through maturity Models, such as SMART** The CITY supports the development of resilience in other CITIES, playing the role of facilitator **125. Encouragement to all stakeholders to be proactively involved in the Resilience development process.** The CITY promotes the involvement of all relevant stakeholders, including citizens, in the Resilience development process **126. The CITY acts as a reference for other CITIES which look for advice and information sharing** The CITY presents itself as a reference for other CITIES, disseminating obtained results and making publicly available the used methodologies. **127. Involvement in international research networks to permanently improve its Resilience.** The CITY takes part proactively in Research networks to be permanently updated about current best practices
Learning	**128. Leadership for knowledge transferring among cities and regions** The CITY acts as a leader concerning knowledge transfer **129. Share and exchange knowledge with global cities that enables learning from best practices around the world** The CITY implements benchmarking formal procedures to be permanently updated about best practices **130. Involvement of agents, including citizens, to take part in the learning process**

The CITY involves relevant agents in the learning process, getting valuable information from these agents and disseminating gathered information to them

131. Development of formal procedures to assess the effectiveness of the learning process

The CITY implements formal procedures and indicators to manage the learning process

132. Build a CITY brand to become a reference within the partnerships in the context of risk mitigation

The CITY develops tools and mechanisms to be acknowledged as a Leader concerning resilience

6. CONCLUSIONS

Resilience is a concept that has been applied to different entities. As a consequence, the concept of resilience has needed to be redefined. In the context of this SMR project, we have been working on European resilience, using cities as main unit of analysis as cities are the key component for European resilience.

The challenge of developing tools and methods that can support the development of resilience in European cities is significant, due to their substantial diversity. SMR project includes a meaningful diverse representation of European cities, through seven cities that vary on size, experience and background concerning resilience, culture, geographical characteristics and types of more frequent shocks.

Anyway, there are also some common aspects that can be observed in all the cities. For instance, all of them started their resilience building process focusing in one, or some few types of risks, the ones they perceive as more probable. These common aspects that can be found at some high, strategic level have been the main inputs for the development of the SMR definition of City resilience and the maturity model presented in this deliverable.

One of the first key results of the SMR project has been the development and acceptance of a definition for CITY Resilience has been defined as “the ability of an urban system or community to resist, absorb, adapt and recover from shocks and long-term stresses to keep the city functioning as a functional unit (vertebra) of society’s resilience backbone, and to learn from on-going processes through city and cross-regional collaboration to anticipate future demands and strengthen the general preparedness, through an understanding of the risk landscape and developing appropriate risk mitigation strategies”.

This definition is wide and it still needs some tools to be operationalized. As the development of resilience in European cities is a process that will need a significant amount of years, even decades. The SMR project presents a “step by step” method to develop resilience within European cities. Every step (or stage in the Maturity Model) presents some key characteristic which is explained in its definition. In addition, every stage includes a set of policies that supports the full achievement of this stage in every city.

Although the cities taking part in the project vary significantly, they have accepted as valuable the definition of every stage of the SMART Maturity Model. They have also contributed to the definition of a

set of policies for every maturity state. These policies act as a operational guide for the development of Resilience within cities.

The main challenge for the development of the Maturity Model has been the level of detail when defining these policies. If the policies were defined at a very strategic level, they were more difficult to implement; if they were too detailed, the amount of policies increased significantly and they refer to specific aspect that may not be relevant for all the cities. Finally, Policies were defined at a quite high level, so they were valuable for all the cities, and they will make more specific and operative through the tool “Portfolio of Resilience Building Policies”

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ANNEX I. OVERALL VIEW OF THE PRELIMINARY RESILIENCE MATURITY MODEL

Annex I presents the whole Preliminary Resilience Maturity Model. This Maturity Model defines five maturity stages: Starting, Moderate, Advanced, Robust, and verTebrate. Each of these maturity stages includes the following components: a description of the objectives of each stage, the agents involved in each maturity stage in addition to a set of resilience building policies to implement in order to reach de objective of each stage. The policies have been classified using five dimensions: Leadership & Governance, Preparedness, Infrastructure & Resources, Cooperation and Learning.

With this complete view of the Preliminary Resilience Maturity Model, it can be seen in which maturity stage the policies should start their development, and how these policies evolve over different maturity stages. Additionally, it can be seen how he number of stakeholders engaged in the resilience building process increases as we make progress in the maturity stages.

	Stages	STARTING	MODERATE	ADVANCED	ROBUST	VERTEBRATE
		INTERNAL INCIPIENT RESILIENCE MANAGEMENT (Definition of resilience action plan)	TOWARDS RESILIENCE MANAGEMENT (Implementation of resilience action plan)	SYSTEMATIZATION/ operationalization OF RESILIENCE action plan	COMMITMENT AND INVOLVEMENT OF THE AGENTS TOWARDS RESILIENCE INTERNATIONALIZATION OF RESILIENCE	LEADING RESILIENCE CITY
	Stakeholders involved	**Local Government, Emergency services, CIs**	Local Government, Emergency services, CIs **Public-private companies, NGOs, Volunteers, Regional government**	Local Government, Emergency services, CIs Public-private companies, NGOs, Volunteers, Regional government, Media **Citizens, Academic and scientific entities, National government**	Local Government, Emergency services, CIs Public-private companies, NGOs, Volunteers, Regional government, Media Citizens, Academic and scientific entities, National government **European legislative body**	Local Government, Emergency services, CIs Public-private companies, NGOs, Volunteers, Regional government, Media Citizens, Academic and scientific entities, National government European legislative body **International organizations**
Description		So far, the crisis management is based on risk assessment without having an integrated approach towards multi-hazard approach; therefore, any risk assessment is still fragmented and incomplete regarding hazards. Critical Infrastructure providers operate independently of each other, therefore there is a need for greater organisation and cooperation among the Critical Infrastructure providers, especially in times of emergency when a disruption to one Critical Infrastructure can have cascading effects across other infrastructures. Measures to improve Critical Infrastructures' realiability and robustness are identified and start implementing. Different city departments have started developing resilience policies however, there is no coordination between the different activities conducted by different departments. Having a common strategy among the municipal departments is still missing. Additionally, the relevant stakeholders and sectors outside the municipality work also independently from others. In this context, the local government recognizes the need to develop an integrated resilience action plan with common practices and approaches, so that the resilience approach/strategy is included in the city's agenda at a strategic level. This way, the city makes the resilience strategy central to the Municipality Plan although the resilience action plan is still focused on dealing with shocks without considering chronic stresses. The city has developed a risk assessment to anticipate failures and mitigate risks as an input for the resilience action plan. A risk register is used to evaluate impact and probability of indivdiual risks, which helps to develop risk mitigation strategies for highest priority risks at city. At the moment, the resilience action plan is limited within the city's borders.The local authority adopts a local governance approach, not recognizing yet the need for a multi-governance approach. As a consequence of this local governance approach, there is a lack of collaboration with sub urban or regional stakeholders. The participation of the local municipality in resilience networks is also incipient.	The risk assessment with regard to hazards affecting Critical Infrastructures is operationalized in cooperation with Critical Infrastructure providers in order to deliver essential services in case of crisis or emergency, defining measures to rapidly bounce back maintaining the previous level of functioning. The resilience action plan includes policies to be prepared and respond to **shocks and chronic stresse**s using a holistic approach. The city uses a more holistic approach to risk assesment through using the risk register to reflect on interdependencies between risks. Identify 'potent' risk policies that can manage a number of risks in a risk area and focus on allowing the city to pay attention to 'bouncing back' from both shocks and stresses. The city sets up the organizational structure to manage the resilience action plan and deploys resources for its development. The city starts monitoring the implementation of the policies included in the resilience action plan using control measures, although there is a lack of a formalized resilience management process. A communication strategy that will scale up resilience building efforts is set up.The city carries out initiatives such as events and training activities to increase the awareness level of the different stakeholders to foster a resilience culture among them. The city starts the development of a multi-governance approach defining accordingly a strategy to strengthen this approach. Regarding collaboration, the city recognizes the importance of networks and platforms for engagement of stakeholders and knowledge sharing. At this point, the platform is internal to the municipality and emergency services. Moreover, the city has started planning for networking with other cities at regional level with regard to resilience and sustainability.	The city has developed an operational resilience action plan with holistic approach that integrates all sectors and relevant stakeholders. The resilience action plan contains measures to increase the flexibility of city infrastructures to deal with shocks and stresses and to adapt to on-going circumstances. The resilience action plan implements a risk assessment that includes measures to rapidly bounce back (maintaining the previous level of functioning) and 'bounce forward' (taking opportunities as they come along to thrive under change). The progress of the resilience action plan is monitored using leading and lagging indicators in order to assess the effectiveness and impact of the implemented policies. The resilience action plan is continuously revised based on the non-compliances identified and improved including lessons learned and best practices obtained through institutionalizing regular debriefing sessions to facilitate a shared understanding, reflection and discussion. Fostering community resilience and public &private cooperation is part of the resilience approach. The city recognizes that in order to increase the engagement and mobilization of relevant stakeholders there is a need for a shift from top-down city level to bottom-up initiatives. Providing incentives for citizens and private sector to provide with solutions they can implement at local level helps strengthening social cohesion and support the goals of the resilience action plan. The municipality changes its role, becoming a facilitator instead of having a central guiding policy role. The multi-governance approach with a European dimension is included in the plans, but not yet fully operationalized. The city is member of a major network of European cities with regard to resilience and sustainability.	All relevant stakeholders to be involved in the resilience action plan have been identified and engaged the majority of them, so in this stage we can speak of a CITY. Stakeholders are proactive and perceive value added by resilience on their quality of life and economy. They are also aware that the resilience approach is a never ending process where the CITY is always in a 'perpetual beta' mode. Resilience is part of daily thinking and acting. The resilience action plan is monitorized and assessed based on regularly collected information and the successes and possible draw-backs of the process are reported, giving feedback for the resilience action plan revision process. The focus will be on making system and community resilient and not place sole responsibility on the individual employee and citizen. The resilience action plan is continuously improved and updated based on the feedback and suggestions received from the city stakeholders through consultation processes and participatory platforms. The CITY is capable of 'bouncing back', 'bouncing forward', and ensuring protection from shocks and stresses. The CITY must work with direct democracy including local decision-making power within a given framework. The CITY administration and organization must be flexible to adapt and evolve as the threat landscape continuously shifts. Local communities can work as self-organized systems that can deal with the uncertain situations. The multi-governance approach with a global dimension is well developed and operationalized. The CITY is participating in a variety of important networks with regard to resilience and sustainability, with a proactive posture and continuous learning, transferring knowledge and best practices to be prepared for any unknown events.	The CITY excels regarding its resilience as part of the regional, national and global system resilience, understanding that in order to become resilient the environment needs to be resilient as well. The CITY is active both nationally and globally to spread resilient and sustainable initiatives. The CITY acts as a vertebra in the European resilience backbone and has an internalized resilience culture. The resilience action plan is continuously improved based on lessons learned from past events. There is a full integration of all known stakeholders in the resilience action plan, with a high level of participation of these stakeholders in the decision-making process. Communities are able to self-organize in order to help in case a crisis occurs. The CITY acts as a leader in global networks and participates in the definition of resilience standards. Actions implemented in the CITY are presented to third parties as best practices. The CITY is proactive supporting the development of Resilience in other CITIES and Regions as it understands the coexisting in a more resilient environment makes the CITY more resilient
		1) Incipient policies for resilience development 2) Lack of integrated approach towards multi-hazard approach 2) Risk assessment incomplete 3) Community involvement/ public-private cooperation incipient 4) City centred 5) City is not part of larger networks 6) Limited funding or no budget for resilience	1) Implementation of resilience policies using effecctive control mechanisms 2) Creation of a department/committee for coordinating resilience development 3) Risk assessment of threats affecting CIs threats 4) Plans to improve cooperation among all the stakeholders 5) The city recognizes the relevance of multi-governance approach 6) Networking with global cities 7) Communication platform established and in use	1) Develop a framework to manage and operationalize resilience 2) monitorization of the action plan through leading and lagging indicators. 2) Community resilience and private-public cooperation are fostered 3) Multi-governance approach with European dimension well-linked but not fully operationalized 4) City member of a major network 5) Co-creation of local institutions companies and research and innovation centers	1) Engagement of all the agents->CITY 2) Agents perceive value- added by resilience 3) Multi-governance approach well developed and operationalized 4) City member of a major network and with a proactive posture and continuous learning 5) Awareness about city resilience level	1) The City is proactive promoting resilience practices 2) The CITY defines its policies and plans understanding that it is part of a ecosystem that has to be resilient 3) CITY acts as a vertebra in the European Resilience Backbone 4) There are implemented and accepted procedures for the continuous improvement of the resilience action plan
	Leadership & Governance	**(1)** Integrate resilience into new visions, policies and strategies for city development plans	**(23)** Establish a resilience department or committee to steer and coordinate the city's resilience action plan and a cross departmental coordination board - Institutionalize the resilience action plan by developing a new organizational structure in the municipality, including the CRO position alongside other supporting roles			**(96)** Active Participation in a network to share lessons learned and best practices with other EU cities (or more networks)
		(2) Establish a working team responsible for resilience issues in the city	**(24)** Establish a committee responsible for monitoring the implementation of the resilience bulding plan, coordinating the actions across the different stakeholders and raising any new challenges **(25)** Develop procedures for cross departmental coordination assigning responsibilities, duties and resources regarding the resilience action plan			
				(49) Support citizens and private sector initiatives that contribute to build resilience at local level (grants)		**(97)** Self organization of the cooperation between public and private agents for the development of Resilience in the CITY
		(3) Develop city plan (challenges, statistics, geographic areas) that give measures and financial measures				
			(26) Develop a white paper about multigovernance approach that aims at integrating the EU dimension **(27)** Align, integrate and connect the resilience action plan with regional plans	**(50)** Develop a plan for multigovernance approach involving the municipal, regional and national levels of governance **(51)** Align, integrate and connect the resilience action plan with national plans	**(72)** Operationalize the multi-governance approach with EU dimension **(73)** Align, integrate and connect the city resilience plan with regional, national and international resilience management guidelines	**(98)** Embedment of Resilience standards and guidelines in every plan or policy that the CITY implements

			(52) Develop a legislative framework identifying obligations and constraints to ensure the implementation of resilience action plan	**(74)** Coordinate with national and international authorities to apply and adapt policies and legislation to municipality action plan	**(99)** Encouragement to proactive participation of Citizens in the Resilience development process **(100)** Encouragement to all the involved agents, including citizens, to provide feedback about the resilience development plans and policies
	(4) Communicate information on risks and protection measures widely to stakeholders so that they can react appropriately	**(28)** Develop a communication strategy to inform the stakeholders about the targets and goals of the resilience action plan highlighting co-benefits	**(53)** Communication of the resilience action plan to the citizens		**(101)** 101. Leadership of resilience projects (EU funded projects or other joint initiatives)
	(5) Develop a preliminary resilience action plan to respond to shocks	**(29)** Develop a resilience action plan to respond to shocks and stresses using a holistic approach			**(102)** Development of formal procedures to monitor risk mitigation strategy/policy implementation and impact.
	(6) Create a simple Risk Register which is used to evaluate proposed policies on the individual basis. This involves generation of a list of risks mainly focussed on sudden shocks, and assessment of their impact and probability.	**(30)** Extend use of Risk Register to identify long term chronic stresses for the city and reflect on the interdependence between risks.	**(54)** Refine the Risk Register with respect to the risks experienced in the city.	**(75)** Refine Risk Register with respect to the risks experienced in the city/region AND in Europe. Use of Risk Register to evaluate proposed policies AND to identify long term risks, and their interdependence, for the city/region/Europe.	
			(55) Assess risk scenarios which involves exploration of possible long term ramifications of risks and their cascading effects. Use of Risk Systemicity Questionnaire for policy analysis.	**(76)** Evaluate regularly (twice yearly) overall evaluation of risk scenarios facing the city.	**(103)** Develop the Risk Systemicity Questionnaire into a Policy testing simulation model. This can be used to monitor and re-focus mitigation actions if necessary.
	(7) Establish priorities based on risk assessment of potential events at the city level (probability x impact).	**(31)** Prioritize risks with respect to both short term (events) and long term 'creeping' scenarios (networks of risks).		**(77)** Prioritize risks exteded to the European level. Appropriate cost-benefit analyses undertaken which informs the prioritisation of risks.	**(104)** Evaluate value for money which informs the prioritisation of risks.
	(8) Develop mitigation strategies for the individual risks.	**(32)** Develop mitigation policies/strategies with respect to high risk areas. This involves identifying potent policies/strategies that can 'hit' many risks within the risk areas.	**(56)** Monitor key risks (through an evaluation of developing risk scenarios) and coordinate policies/strategies for targering high risk areas with relevant stakeholders at the city/regional level.	**(78)** Coordinate policies/strategies for targeting high risk areas with relevant stakeholders at the city/regional and European level and are informed by the Europen perspective.	
	(9) Make a list of priorities for essential services and core resources (identify essentials and non-essentials).	**(33)** Develop/Establish leading indicators to assess and monitor resilience action plan		**(79)** Identify and train organizational abilities to re-structure and adapt in response to a variety of anticipated threat scenarios	**(105)** Assessment of the efficiency of training activities **(106)** Permanent refinement of training programs based on assessment. **(107)** Development of training plans in cooperation with other CITIES.
			(57) Implement centralised control of coordination of critical resources and activities to make resources accessable to local initiaitives during a crisis.		
	(10) Develop a diagnosis and assessment of the city's vulnerabilities, risks and strengths	**(34)** Review best practices used in different sectors that relate to the resilience action plan **(35)** Identify key assets (strengths) relevant to cope with known variations and disturbances. This includes and analysis of enabling factors for each asset.			**(108)** Active submission of training materials to other CITIES **(109)** Development of training activities for other CITIES **(110)** Assessment of the value added by its contributions to the Resilience of other cities
	(11) Update existing plans and response mechanism guidelines for emergency situations	**(36)** Set up early warning, monitoring systems to alert for potential arising risks			
		(37) Develop clear procedures to collect, classify and share data to comply with legal implications. The procedures should include information about what data must be collected for, how to store and use it to ensure systems continue working during a shock or stress			
	(12) Conduct training and arrange emergency drills and exercises with the emergency teams	**(38)** Provide training to the volunteers	**(58)** Conduct frequent joint training exercises with CITY's relevant stakeholders to ensure their efficient collaboration **(59)** Develop education programs in schools explaining the goals and actions of the resilience action plan **(60)** Train local organisations and individuals to make use of local resources during crisis	**(80)** Provide training courses for citizens and companies based on their specific needs and conduct frequently public drills (national level)	**(111)** Conduct frequent joint training exercises between European cities with the involvement of all the stakeholders included in this stage (international level)
			(61) Encourage companies to have appropriate insurance coverage and develop business resilience plans	**(81)** Encourage citizens to have appropriate insurance coverage and develop household resilience plans	**(112)** The CITY monitors that the insurance level of citizens and companies is the suitable one.
		(39) Promoting a culture of resilience organizing resilience awareness activities such as campaigns, events and training activities for all the stakeholders		**(82)** Arrange public debriefing sessions to facilitate a shared understanding, reflection and discussion on the resilience building process with stakeholders outside the municipality **(83)** Identify and train organizational abilities to re-structure and adapt in response to a variety of anticipated threat scenarios	**(113)** Self-organization of Involved agents to improve the development of the Resilience of the CITY. **(114)**Encouragement of Involved agents to present their experiences concerning Resilience development as a reference for agents from other CITIES **(115)** Development as a reference for agents from other CITIES
	(13) Develop cooperation/collaboration agreements with critical infrastructures for ensuring the continuity of critical services in case of crisis or emergency.				
		(40) Develop internal audits to ensure critical infrastructures have emergency plans and comply with rules and legislation to deliver essential services in case of crisis or emergency **(41)** Develop a contingency plan aimed at keeping CI functioning at minimal level in case of disaster			

Preparednes

Policies

Infrastructure & Robustness	**(14)** Develop measures to increase critical infrastructure redundancy and reliability		**(62)** Develop measures to increase the CITY infrastructures' flexibility		**(116)** Integration of CITY Infrastructures as components of a wider network **(117)** Integration of the plans to increase the Resilience of the Infrastructures and refined understanding these Infrastructures as components of a wider network
	(15) Develop periodical maintenance procedures to guarantee the correct level of performance of critical infrastructures				
		(42) Integrate the resilience action plan into the local government budget to increase the resilience of the city		**(84)** Provide incentives for public and private sectors that invest in measures that increase the resilience and penalties to those who increase the risk and vulnerabilities	**(118)** Establishment of the Redundancy level of the Infrastructure of the CITY according to efficiency criteria **(119)** Establishment of a strong network of volunteers which is able to self-organize **(120)** Refinement of resilience policies to take advantage of any shock and stress to bounce forward and improve or re-design.
	(16) Develop a list of the current resources available	**(43)** Deploy a disaster relief fund for emergencies		**(85)** Develop a methodology and action plan to enhance the quality of our welfare services without increasing in public spending	**(121)** Refinement of the budget for Resilience so it is taken into account whenever the overall budget of the city is discussed.
			(63) Integrate resilience action plan with urban planning to understand future resilience requirements and identify infrastructure projects. **(64)** Relocate housing programs to move households and companies out of hazard areas and into safe locations, and remove existing damaging infrastructure		
Cooperation	**(17)** Map and bring together relevant stakeholders for the development of the resilience action plan **(18)** Develop/Create a common understanding of resilience among different stakeholders	**(44)** Develop a stakeholder engagement plan to structure their interaction (with a clear definition of their roles and responsibilities) increasing the awareness of stakeholders on resilience action plan		**(86)** Establish cross disciplinary collaboration to foster long term planning	**(122)** Self-organization of the cooperation among all the agents involved in the Resilience development.
	(19) Develop a public website with updated emergency information and communicate advice and support to citizens during any shock events	**(45)** Develop an internal website/communication platform that offers secure online space for sharing information with different municipal departments and emergency services	**(65)** Develop a communication platform/website that allows the interaction between the municipality and other stakeholders to provide input, suggestions and comments about the resilience building process	**(87)** Enable public platforms (i.e. databases) to enhance the sharing of resilience lessons learned and best practices among city stakeholders. **(88)** Undertake public consultations for the development and design of resilience actions-plans to support their implementation and receive continuous feedback by citizens and stakeholders.	**(123)** Active involvement in networks to share lessons learned and best practices
		(46) Collaborate/Establish alliances among cities with similar risks to strengthen the collaboration **(47)** Scout and assess current initiatives, projects and funding opportunities such as EU-Projects/Programmes to eventually join alliances	**(66)** Join a major Network of EU cities	**(89)** Widen collaborative networks with representatives from the CITY stakeholders (emergency services, critical infrastructures, public and private companies, academic entities, media, citizens, and volunteer organizations) to ensure the performance of duties, to reflect on and make decisions about the progress of the city's resilience. **(90)** Become active in a major network of EU cities to promote initiatives, exchange experiences and increase cooperation **(91)** Proactive participation in regional, national and international networks to promote initiatives, exchange experiences and increase cooperation with continuous learning	**(124)**Facilitation of other cities through the process of developing resilience through maturity Models, such as SMART **(125)** Encouragement to all stakeholders to be proactively involved in the Resilience development process.. **(126)** The CITY acts as a reference for other CITIES which look for advice and information sharing
	(20) Establish small collaborative groups within a city (district, neighbourhood) on specific in smart city topics		**(67)** Develop partnerships (like research projects) with academic and scientific entities that contribute to the development and understanding of the resilience building process in the CITY.		**(127)** Involvement in international research networks to permanently improve its Resilience.e
Learning	**(21)** Establish and maintain a database of past shocks and current risks for learning purposes	**(48)** Analysis of lessons learned from past emergencies internally with the different entities of the emergency services.	**(68)** Integrate lessons learned from past emergencies in resilience action plan		**(128)** Leadership for knowledge transferring among cities and regions
			(69) Share best practices with other municipalities		**(129)** Share and exchange knowledge with global cities that enables learning from best practices around the world
				(92) Create a Learning city: to work in partnership to create and promote learning opportunities (all ages, all parts of city)	**(130)** Involvement of agents, including citizens, to take part in the learning process
	(22) Develop a strategy to create a resilience culture, learning from experience and integrating city departments and stakeholders		**(70)** Formalize the learning process, institutionalizing regular debriefing meetings	**(93)** Arrange multi-stakeholder debriefing sessions to facilitate a shared understanding, reflection and discussion on the resilience building process to guarantee continuous learning **(94)** Establish multi-stakeholder debriefing meetings with representatives for the city stakeholders to evaluate and improve the city's resilience plan based on lessons learned and past events.	**(131)** Development of formal procedures to assess the effectiveness of the learning process
			(71) Establish learning partnerships in the context of risk mitigation with relevant stakeholders at the regional/city level.	**(95)** Establish learning partnerships in the context of risk mitigation with relevant stakeholders at the regional/city, National AND European level. Learning from effectiveness of risk assessment and mitigation.	**(132)** Build a CITY brand to become a reference within the partnerships in the context of risk mitigation