

# CITY RESILIENCE: ANALYSIS OF STRATEGIES WORLD-WIDE

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## Abstract

In recent years, resilience has become an important goal for cities, particularly in the face of political uncertainty, climate change and increasing urbanisation. Resilience theory has yielded informative lessons and brought new perspective when preparing for, and responding to vulnerabilities cities face today, such as natural hazards and social inequalities. However, critical questions on how to operationalize resilience through political decision making and community engagement are still unanswered, and supporting methods and concrete action plans are needed. In this paper, we offer an overview of the result from three studies conducted as part of an ongoing H2020 research project, Smart Mature Resilience. The three studies include a literature review of definitions and approaches in city resilience, analysis of city resilience strategies and requirements for standardization. Key findings from the studies are presented and implications of their findings for the development of resilience management guidelines are discussed.

## 1 INTRODUCTION

Increasing resilience to crises and disasters is a topic of highest political concern worldwide. The need for cities to prepare for, prevent and manage the effects of natural hazards and man-made threats such as floods, storms, earthquakes, tsunamis, accidents and terrorism is becoming increasingly imminent. This need is reflected in recent initiatives. In 2015, the UN General Assembly endorsed the Sendai Framework for Disaster Risk Reduction 2015-2030 (UNISDR, 2015), aiming to achieve reduction of disaster risk in economy, social issues, cultural assets and environmental resources over the next 15 years. In addition, Resolution 339 was adopted by the Council of Europe and the aim is to support the UN campaign “UNISDR Making Cities Resilient” to implement local adaptation processes such as sharing best practices and developing partnerships between countries. Similarly, the OECD provides a comprehensive report supporting the Sendai Framework and the New Urban Agenda of the UN through its analysis of approaches, policies and concrete city actions worldwide (OECD, 2016). Another world-wide network in focus in this paper is the 100 Resilient Cities<sup>1</sup> (100RC) initiative, established by the Rockefeller Foundation, aiming to support and improve resilience at the community-level worldwide (Arup, 2014).

The growing political interest in resilience approaches to tackle future challenges is an important first step. However, current frameworks have been criticized for being of limited relevance to local realities and lack an understanding of the complex risk landscape that shape today's cities (Oxley, 2015). Recent literature reviews on city resilience show concurring findings, including a great variety in attributes and indicators used, reflecting the lack of consensus and unification of central themes (Meerow, Newell, & Stults, 2016; Rankin et al., 2016). An important challenge is going from theory to practice, that is, from theoretical models of resilience to methods and concrete action plans.

Smart Mature Resilience<sup>2</sup> (SMR), a current H2020 European project, aims to address some of these issues by developing, testing and validating European Resilience Management Guidelines (ERMG) for city resilience operationalised through five support tools: 1) a Resilience Maturity Model defining the trajectory of an entity (system, community or society) through measurable resilience levels; 2) a Systemicity Risk Questionnaire that, beyond assessing the entity's risks, also includes analysis of interdependencies between risks and potential cascading effects; 3) a portfolio of Resilience Building Policies that support the entity's progression towards higher maturity levels; 4) a System Dynamics Model (computer simulation model) that embodies the Resilience Maturity Model, allowing to diagnose, monitor and explore the entity's resilience trajectory as determined by resilience building policies, and 5) a Resilience Engagement and Communication Tool to integrate the wider

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<sup>1</sup> <http://www.100resilientcities.org/>

<sup>2</sup> <http://www.smr-project.eu/home/>

public in community resilience, including public-private cooperation. Further, a European standard will be developed based on the ERMG, supporting sharing of data and facilitating comparisons between cities in Europe. Several studies have been conducted to gather needs and requirements for the ERMG. This paper presents key findings from three of these studies; (1) literature review of academic articles and world-wide reports on city resilience, (2) city resilience strategy analysis of 18 cities and (3) standardization requirements for development of a standard. The final section of the paper identifies a set of implications from the results for guideline development.

## 2 LITERATURE REVIEW: KEY FINDINGS

To gain insights into how resilience in a city context is defined, discussed and applied, a review of 119 peer-reviewed journal articles and 23 reports on world-wide city resilience initiatives was carried out (Rankin et al., 2016). The analysis of the research articles focused on three overarching areas; resilience definitions and problem areas, related concepts and applications of resilience. The reviewed reports came from organisational bodies and cities worldwide, and focus areas for our analysis were resilience implementation, evaluation, metrics, best practices, and policies. Below, we present key areas from the reviewed literature identified as requiring particular attention. For the full description of the method and results see Rankin et al. (2016).

### 2.1 Conceptual Tensions

The literature demonstrates a large variety in definition and approaches, reflecting a lack of consensus and unification on the notion of city (and urban) resilience. The lack of consensus also reflects the vast number of areas and goals that are important to resilience and city management. Several “sub-fields” of relevance to city resilience were identified, such as, community resilience, social resilience, crisis/disaster resilience, infrastructure/engineering resilience and economic resilience. Definitions between and within the different fields vary, including some fundamental differences in perspectives and assumptions made. For example, literature on disaster resilience tends to focus on cities ability to “*bounce back*”, that is, to recover from an event and “get back” to its previous state (Manyena, 2006). In infrastructure and engineering resilience, definitions focus to a higher extent on abilities to “*absorb*” disturbances, and in community and socio-ecological resilience highlights *adaptive abilities* to on-going circumstances (Folke, 2006).

The different theoretical perspectives have distinctive implications on how research and applications of resilience should be managed (see Woods, 2015). It may be argued that different aspects of the resilience concept are suited for different areas of city resilience; as goals vary between different parts of the urban system. For example, with regards to critical infrastructure, the ability of a network to cope with, or “absorb” short-term disturbances through robustness and redundancy may be a key feature, whereas a key property of a resilient community is its ability to adapt to both short- and long-term changes. Moreover, the fundamentally different use of terminology in this area can be an obstacle making collaborative efforts between researchers, politicians, private companies and citizens difficult.

### 2.2 Safety I and Safety II - Dependencies and Cascading Effects

Frameworks for city resilience, such as the Sendai framework (UNISDR, 2015) and the 100RC Resilience Framework (Arup, 2014), still have a focus on risk reduction, rather than on a holistic approach including both risk management (Safety-I) and general capacity and flexibility (Safety-II). Main topics of the analysed frameworks include: understanding and education on disaster risk, strengthening disaster risk governance, investing in risk reduction and enhancing responsiveness. The focus on risk and a faulty conceptualization of resilience solely as risk reduction management may seriously reduce the understanding of the complexity of the issue since many cities already have a risk management approach in progress, and hence “resilience”. However, to help deal with the complex issues of increasingly interdependent systems, resilience has to go beyond traditional approaches of relying on predictions and risk reduction, and focus attention on *general capacity* to tackle a broad range of risks helping cities prepare for combined impacts and unintended consequences. As discussed by the 100 Resilient Cities Network (100RC, 2016) risks may take different forms, as (sudden) acute shocks, but also gradually evolving chronic stresses. Resilience is about being pro-active, with the aim to prepare systems to cope with variation through adaptation and flexibility, and to stay alert to system variations and the changing shape of risk (Hollnagel, 2011).

However, identifying feasible ways to model and analyse the dependencies and cascading effects of disturbances is a big challenge. For example, changes and disturbances in a cities infrastructure almost never have a single effect on the city’s resilience but can have far-reaching effects in many different realms of society. If the electric power grid, water supply and communications (transport and ICT) infrastructure is not secured during a crisis the batteries in cellular towers will be depleted and all communication will be affected. However, the infrastructure sits within complex national and global frameworks with inherent co-

dependencies and weak points. The dependencies, numerous stakeholders (subcontractors) and legal frameworks render the management of infrastructures on the local level difficult. Reverberating effects and events and actions should, however, not only be seen in the light of increased risks and vicious circles; effect may also be positive. City initiatives show that individual projects such as a park can give the community members not only a green place to spend their afternoon, it can also be a meeting place for different groups to support social cohesion. Additionally, its permeable soil can increase resilience against flooding and decrease effects of heat waves. The trees absorb green-house gases and the park is a place of education where the community can learn about ecological principles.

Attempts to model dependencies, cascading effects and reverberations within a city is, besides individual case-studies, only done on a very high level (Hagen, Tzanetakis, & Watson, 2015). The challenges in developing generalisable frameworks and models for complex entities like cities are manifold, including the identification of boundaries and scope, interconnected and influencing factors, combined effects of risks, vicious feedback loops and contextual dependence (Rankin et al., 2016).

### **2.3 Going from Theory to Practice**

From our literature studies it is clear that existing resilience frameworks are abstract and high-level, which means that there is a lot of work required to contextualise and implement existing models and methods on the city level. A benefit of using high-level concepts are that it offers a way to include many areas, and an abstract way to consider the multiple processes and stakeholders involved, and their interactions. The downside of more general models is that they must be translated to a specific context, which can be cumbersome and challenging for practitioners. Challenges include untangling and contextually defining multiple dimensions and parameters of complex cities, as well as prioritizing action and definition indicators.

Additionally, as mentioned earlier, the current literature review underlines the lack of consensus of the resilience concept and how it should be included in the frameworks. The large variety of framework attributes/indicators makes comparisons of the frameworks challenging, which makes it difficult for city representatives to apply resilience in everyday work.

## **3 CITY RESILIENCE STRATEGIES ANALYSIS: KEY FINDINGS**

The resilience strategies prepared by 18 cities being part of the Rockefeller Foundation network of 100 Resilient Cities<sup>3</sup> was analysed. The data consisted of official documents and webpages. The study focussed on identification of the subjective challenges the city faced, goals of the resilience work, and plans of action to approach identified goals. All five continents are represented in the analysis, including five cities in North America, four in South America, two in Asia, three in Europe and two in Australia (for the analysis see Rankin et al. (2016)). The analysis was performed coding the data with a subsequent thematic analysis (Braun & Clarke, 2006), with the goal to capture city challenges and planned actions. Three top-down categories were used in the analysis: (1) vulnerabilities, (2) approaches and, (3) affected groups. Furthermore, a bottom-up approach was applied to the data, allowing sub-categories to take form, nuancing the data.

Following the analysis, a set of interviews were carried out with six city representatives from three different European cities involved in the process of developing and implementing the city strategies. Two of the cities were in the process of finalising their strategy and one city had completed the strategy and was in the early stages of implementation. The interview was centred on the process of developing and carrying out the strategy.

### **3.1 City resilience strategies: Vulnerabilities, solutions and affected groups**

The vulnerabilities can broadly be classified under the categories of social issues, climate change and critical infrastructure. Vulnerabilities associated with social dynamic vulnerabilities were first and foremost concerned with different forms of social exclusion (e.g., unemployment, immigration, elderly) and the lack of access to societal services such as health care. Vulnerabilities regarding climate change were either concerned with the general topic of increasing levels of greenhouse gases, or more specific threats such as flooding, draught, storms, or earthquakes. Under the theme of critical infrastructure, common vulnerabilities were water access and waste disposal. The reports also suggested that the cities are concerned with how to maintain communication and transportation services in the face of a disaster. With regards to social issues, cities aim to approach internal management silos as well as improving communication with citizens, business and other stakeholders. A common approach to tackle challenges included creating community plans and expanding present programs/plans. A widely-applied solution was to modify the evaluation processes of already existing

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<sup>3</sup> <http://www.100resilientcities.org/strategies#/-/>. At the time of analysis only 18 cities had finalised their strategy.

projects to also include aspects of resilience, with the aim to make it an integral part of policy-making and everyday operations. Involved stakeholders varied between the three different categories. Solutions related to social issues, on the other hand, commonly involved the ambition for collaboration within the community and its initiatives, as well as creating new business partnerships. With regards to climate change, responsibility were often directed toward the local government and solutions in the form of policies, such as enforcing city departments to lower their energy usage. In the critical infrastructure category, the local government was commonly described as a single actor, making plans for future projects and related knowledge-gaining activities.

To conclude, the results indicate that the resilience strategies and concrete actions of the 100RC cities are mainly focused on measures to improve community cohesion, information gathering (monitoring), and resilience-thinking based on graceful management of “disasters” (e.g. being in control of a flood). Furthermore, the solutions proposed were in many cases multifunctional and multipurpose, suggesting that cities put effort into identifying dependencies between identified vulnerabilities and potential effects the solutions may have in the long and short term.

### 3.2 City Resilience Strategies: Results from Interviews

The interviews with city representatives focused on the process of developing a strategy and related problems. Main challenges mentioned illustrate well the issues discussed in the literature with regards to operationalising a broad concept to a complex system. Two main issues surfaced in all interviews:

- Politics and collaboration - this issue concerns who “owns” a problem and how to coordinate the many involved stakeholder, both public and private, and getting necessary expertise and involvement.

Resilience is not a solo project, but rather something closely tied to multiple activities in the city, such as city planning, crisis preparedness, health care and critical infrastructure. The interconnectedness forms a challenge of getting necessary stakeholders and expertise involved to propose a feasible resilience strategy. In many cases the involvement is voluntary, and thus the initiatives must be sufficiently “inviting” to all partners. Furthermore, in larger cities it is not possible to have a single and central administration as it is divided into districts. Who “owns” key areas, such as waste management, public transportation and policing may vary between the central government and the individual district. In Rome, for example, this difficulty was solved by dividing the strategy mapping into two different sectors, one being experts in key fields, and the other being the general population.

- Politics and prioritization - cities have different preconditions and starting points. Identifying and prioritizing an action plan for the local context is challenging. Further, trade-off priorities, politics and funding play an important role.

The second main issue found in the interviews is knowing how to prioritise actions. When it comes to resilience, a lot of work in areas such as social issues and climate change is already seen as being performed, and it is not always clear to city representatives how the concept of resilience will change or strengthen the current efforts. Adding to this issue is the difficulty of city politics, getting projects funded, and the need to be able to motivate and prove idea. One city representative gave the example of how a change in government following an election led to a shutdown of on-going projects and major difficulties in receiving new funding.

## 4 STANDARDIZATION REQUIREMENTS: KEY FINDINGS

It has been argued in this paper that a main challenge in developing tools for city resilience is the need for highly contextualised and local solutions. At the same time, general approaches are important to support world-wide initiatives, foster sharing of data and facilitating comparisons. In this regard, standardization is a tool that supports the dissemination and exploitation of results from research and innovation. Within the SMR project, part of the European City Resilience Guideline will be transformed into a standard. This will be done in three stages: (1) identify related existing standards, (2) gather user requirements and (3) development the standard document through a CEN<sup>4</sup> Workshop. The CEN workshop includes a series of workshops with field experts, and results on a standards document, also called the CEN Workshop Agreement (CWA)<sup>5</sup>.

The comprehensive review of existing standards relating to the topic of city resilience resulted in a list of 270 identified existing standards (Linder & Kempen, 2016), demonstrating again the broadness of the resilience concept. This collection includes related areas such as sustainable development and societal security. Within

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<sup>4</sup> <https://www.cen.eu/work/products/CWA/Pages/default.aspx>; CEN is the European Committee for Standardization.

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these areas existing standards offer, for example, guides to establishing strategies for smart cities and communities, indicators for resilient cities and guidance for managing security in healthcare facilities.

User requirements from city representatives have been gathered through a survey, and followed by a joint workshop of all survey participants and external city representatives. Questions in the survey related to the current use of standards, how standards are shared among city experts and the need for new standards. Results from the survey showed that current use of standards mainly refer to management standards relating to general topics such as quality (EN ISO 9001), environment (EN ISO 14001) and energy (EN ISO 50001). Standards addressing more specific topics related to resilience are generally unknown by the city representatives, e.g., scenario planning - Guidelines for decision making processes dealing with climate change (DIN SPEC 35811). The survey participants reported a need for a new standard supporting three main areas; (1) development of responsive structures within the city (2) cross-sectorial collaboration between city stakeholders and, (3) processes to include citizens in the resilience process. Furthermore, the results show that the city representatives require resilience approaches that can be incorporated into already existing projects and initiatives such as sustainability and smart city.

In the next phase the scope of the standard will be identified, based on an analysis of important existing standards and city requirement. The process of the CWA will support the integration of these two parts. The open structure of such a CWA allows transparency towards all involved stakeholders and interested parties and it ensures a broad consensus of a potential standard's contents. Cities representatives therefore have the possibility to be part of this process; which enhances the future adaption by a wide range of cities. Further, the standard will be available to all European cities, with the goal to support and facilitate resilience development in cities, as well as information sharing between cities. In this regard, the developed city resilience standard will bring together existing standards and the findings from the project research, including findings from the literature and the user requirements gathered from city representatives.

## **5 DISCUSSION: IMPLICATIONS FOR DEVELOPMENT OF RESILIENCE MANAGEMENT GUIDELINES**

The findings from the studies outlined in this paper support continued work in the development of guidelines, practical tools and standards for city resilience. The main implications for further research are outlined below.

- **Joint understanding of the resilience concept and objectives**

The literature review shows that the application of resilience in a city context is fragmented. Different definitions, goals and approaches are used, creating conceptual tensions and challenges in unifying resilience research and initiatives. Implications of different resilience viewpoints are found in the assumptions, objectives, measurements and improvements made by researchers and practitioners. It is thus of utmost importance to carefully consider, discuss and agree on definitions, objectives, viewpoints and strategies with all involved stakeholders, to ensure joint understand of the conducted work. This may be done through, for example, the process of standardization.

- **Identification of risk dependencies, cascading effects and reverberations**

There is a consensus in the literature that research and initiatives in urban resilience has overlooked important couplings between different dimensions of community management, including both social and physical aspects. Indeed, the risks which cities face are usually the consequence of complex interactions between many factors which can often reinforce one another. These interactions can lead to non-obvious, and counter-intuitive, unintended consequences that may be difficult for cities to anticipate. In other words, for practitioners in the public sector, it is limiting to view risks as being independent, instead it is essential to understand risks as forming complex networks. Therefore, suitable tools are needed that can support city staff to identify and explore how risks interact with each other and potentially can affect the city planning. Models and tools should thus compliment current risk assessment approaches and offer practical tools which could be used by cities to improve their thinking about the dynamics between risks in the short and long terms. Analyses of dependencies further offer guidance for possible positive reverberation that go beyond identified goals. It is expected that by taking a more holistic view on risks, in which the knowledge of various practitioners is pooled together to identify and prevent desirable or undesirable dynamics, cities can become more effective in their preparedness. One way to work on this is to identify and draft possible risk scenarios as a way of preparing for risks, and to consider possible knock-on effects deriving from such scenarios. The analysis of city resilience strategies revealed that some cities have already caught on to this idea, and many current resilience projects address multiple vulnerabilities in different areas of the city.

- **Increased support for adaptive and flexible skills**

Many of the frameworks used for resilience today still have a focus on risk reduction, rather than on a holistic approach including both risk management (Safety-I) and general capacity and flexibility (Safety-II). Models and tools should acknowledge and further support Safety II perspectives. For example, a focus on general

capacities, flexibility and multi-stakeholder collaboration across private and public sector will increase resilience and adaptive capacity. Flexible city management processes that foster learning with regards to handling unexpected events is suggested. Policies and metrics should focus on cohesion, communication, flexibility and integration of resilience into the existing city organisation, budgeting and financing processes. Furthermore, improving the general monitoring capacity is a key to improve resilience. Cities need supporting processes for setting up and using monitoring data at different levels.

- **Balance between generalisation and contextualisation**

Current resilience frameworks are abstract and challenging for city representatives to understand to improve work processes. Hence, there is a need for better guidance to support the development of concrete resilience-oriented work processes that city managers and city employees can apply in everyday work. The study of city resilience strategies showed that the approaches to manage local challenges varied greatly between cities, and were adapted to local possibilities and constraints related to the cities' ecology, geology and history. These findings demonstrate that tools, processes, guidelines, and checklists have to be contextualized and appropriated – hence, they need to allow local adaptations to be made. In the development of tools, such as in the SMR project, require a careful balance between general, high-level resilience concepts, and the specifics of the different settings (i.e., cities). The development of such tools would be an important step in the right direction of going from normative to descriptive models of resilience. Such tools would, ideally, support resilience initiatives on both top-down (high-level policy) and bottom up (local initiatives). However, there is also a need for generalisability to support world-wide efforts, to share results and to ensure common understanding between cities and other relevant parties. To ensure that concepts and processes described in the standards are valuable and adaptable to relevant cities the standardization committee works in close collaboration with the users as part of the development process. Not only are city representatives active participating in the development of the envisaged standard, but an optional public enquiry is further applied to allow a broad range of cities to comment on the standards' content.

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