

Towards an integrated approach to urban resilience assessment

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ABSTRACT

As climate change advances, more cities across the world are coming to realize the essential need for resilience-oriented planning. This article summarizes findings of a research project on developing tools and indicators for assessing urban resilience. A mixed-methods approach is taken to investigate various issues related to development and implementation of integrated resilience assessment tools. This includes an extensive review of a vast body of literature published on urban resilience, content analyses of existing assessment frameworks, and employment of methods such as checklist surveys and “structured interview matrix” to use the knowledge of experts in the field. Based on the literature review several criteria are identified that can be used for developing assessment tools suitable for informing decision-making process. Examination of a selected number of assessment tools shows that most of them fall short of appropriately addressing these criteria and further improvements are required. This study argues that resilience is a multi-dimensional concept. The five dimensions identified here are, namely, environmental, social, economic, physical, and institutional. It is emphasized that various criteria related to these dimensions should be appropriately addressed during various planning, absorption, recovery, and adaptation stages of disaster risk management.

1. INTRODUCTION

Throughout history, cities have often been able to endure and recover from climatic and non-climatic shocks and stresses (Vale & Campanella, 2005). However, due to unprecedented urbanization and climate change, the scale of these stresses and disruptions has increased and is expected to increase even further in the future (Field et al., 2014). Increase in frequency and intensity of disruptive events can overwhelm even the most robust urban systems and limit their coping capacity. Advances in the understanding of the potentially dire impacts of climate change has resulted in the widespread use of the resilience concept in science and policy circles (e.g. Resilience Alliance, ICLEI, C40 Cities, etc.). It has also given rise to the emergence of various initiatives around

KEYWORDS

urban resilience, assessment framework, climate change, disaster risk management, mixed-methods approach, structured interview matrix.

DOI

<https://doi.org/10.30852/sb.2017.182>

DATES

Received: 2 September 2016

Published (online): 22 November 2017

Published (PDF): 9 May 2018

HIGHLIGHTS

- » Resilience thinking improves the capacity for disaster risk management.
- » Assessing urban resilience can facilitate a better-informed decision-making process.
- » Factors related to the assessment of urban resilience are identified.
- » Assessment tools should reflect the multi-dimensional nature of urban resilience.
- » Urban resilience assessment should address the issue of context-specificity.

the world that intend to enhance resilience of cities and communities (for further information see Sharifi (2016)). These initiatives are initiated and operationalized by

various entities including national and local governments, Non-Governmental Organizations (NGOs), and donor organizations. More recently, there has also been an increasing trend in the development of initiatives that are centered on partnerships between different cities and communities; the Global Resilience Partnership and the 100 Resilient Cities program are two examples of these partnerships.

The ubiquity of the resilience concept can be attributed to its broad scope and the fact that it can be utilized to frame various issues related to climate- and non-climate-induced disruptions in urban areas. Further knowledge about resilience and its assessment can provide better understanding of transformative approaches that need to be taken in order to develop cities that contribute to climate stabilization and to achievement of the Sustainable Development Goals (SDGs).

The literature on urban resilience is immense and still growing (Cutter, 2015; Fox-Lent, Bates, & Linkov, 2015; Tyler & Moench, 2012; Sharifi, 2016). A number of issues related to social, economic, environmental, physical, and institutional aspects of resilience have been addressed in the literature (Cutter, 2015; Fox-Lent, Bates, & Linkov, 2015). More recently, there has also been an increasing interest in the development of assessment tools that capture the complexity of the resilience concept and make it more tangible for the public and policy makers (Cutter, 2015; Fox-Lent, Bates, & Linkov, 2015, Sharifi, 2016, Sharifi & Yamagata, 2016b). Resilience assessment can also help communities identify their shortcomings and develop action plans to address them. It can also provide learning opportunities through actively engaging different stakeholders throughout the process (Sharifi, 2016).

The main aim of the study is to review literature on urban resilience assessment and identify different issues that should be considered for the purpose of developing integrated resilience assessment tools. Other objectives are to identify various resilience principles and characteristics that should be integrated into urban planning and also to develop a framework for evaluation of existing resilience assessment tools. The study is important as existing assessment frameworks are often fragmented and fail to provide a comprehensive picture of urban resilience assessment. Furthermore, although many assessment tools exist, analyses of their strengths and weaknesses are still scarce. The research project aims to fill these gaps.

The research methods and materials are discussed in the following section. Section three presents the main findings and discusses their implications for urban resilience assessment. The final section summarizes the main points discussed in the study and highlights several

areas for future research.

2. METHODOLOGY

The broader research project was developed based on a mixed-methods approach. Here, only those methods used to obtain the results presented in this study are explained. Before explaining the research methodology, it is essential to clarify what is meant by the term 'resilience' in this paper. Resilience is a contested concept and various definitions can be found for it in the literature (Sharifi, 2016). The definition provided by the National Academies was adopted for this research project. It defines resilience as "the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events" (TNA, 2012, 14).

As one of the main objectives of this study was to identify a comprehensive list of criteria that can be used for assessing urban resilience, an extensive literature review was conducted. A broad review protocol was developed in order to include criteria related to various aspects of urban resilience. As a result, research from various fields including, but not limited to, urban planning, disaster management, sociology, economy, environment, infrastructure, governance, water, and energy was included in the study. Further details about the review protocol can be found in Sharifi and Yamagata (2016a) and Sharifi (2016).

In addition to identifying resilience criteria, the review was also designed to extract a set of measures that can be used for development and evaluation of urban resilience assessment tools. A framework for assessing suitability of resilience assessment tools was developed based on these measures. This framework was later used to critically analyse the selected existing resilience assessment tools. Thirty six tools were selected for this purpose. Content analyses of manuals and other documents related to these tools were conducted to find out if they comply with the measures outlined in the framework.

As resilience is a normative concept, any research related to it should also involve participatory methods to obtain knowledge from a diverse array of stakeholders. Although it is intended to engage stakeholders from different sectors in the project, until this stage this has mainly been limited to researchers and few key actors from NGOs. A four-day workshop was organized at The University of Tokyo in December, 2015. Over 30 participants attended this workshop. A call for applications was distributed several months before the workshop in order to ensure participation of qualified people from different countries. This workshop provided the opportunity for various researchers and practitioners

from different countries to share their knowledge and actively participate in discussions related to urban resilience assessment. During the third day of the workshop the participants were assigned the task of identifying different urban form criteria that enhance resilience of communities.

On the last day participants were engaged in an exercise to discuss answers for four major questions that were identified cooperatively (by the participants) based on the presentations and discussions from the first three days of the workshop. Structured Interview Matrix (SIM) which is a technique that has been used by several researchers to map community assets in a participatory process was used for the purpose of this exercise (T L. O’Sullivan, Corneil, Kuziemsy, & Toal-Sullivan, 2015; T. L. O’Sullivan, Kuziemsy, Toal-Sullivan, & Corneil, 2013). The exercise was conducted in three stages as follows: first, an interview matrix was developed to divide the participants into four groups and assign a specific question to each group (three groups had 4 members and one group had 5. For the purpose of consistency, two members of the latter group were paired). Each participant was engaged in “one-on-one” interviews with a participant from the other groups to collect answers for the specific question. Each interview was conducted in about five minutes and the responses were written down by the interviewer. The process was repeated until each group collected 12 unique answers for its question (each participant answered to three unique questions from the other groups). The facilitator guided the participants on how to complete the interview matrix. Following

the completion of this stage, the groups reconvened to discuss and elaborate on the findings and add their own input. Each group was tasked to identify three main findings for its assigned question. A plenary discussion was organized at the last stage in order to discuss the questions and findings with all participants (T. L. O’Sullivan et al., 2013, 240). This exercise provided an opportunity for all participants to express their opinions and actively engage in discussions.

3. RESULTS AND DISCUSSION

3.1 Different dimensions, criteria, and qualities related to urban resilience

As discussed above, the project aims to create a database of criteria related to different aspects of urban resilience. Criteria related to general urban resilience and urban energy resilience have already been identified (Sharifi & Yamagata, 2016a). For general urban resilience, a total number of 122 criteria have been identified by the authors and categorized into five groups, namely, environmental, social, economic, physical, and institutional. Complete list of these criteria can be found in Table 5 of Sharifi (2016).

Also, 196 criteria related to urban energy resilience were extracted and divided into five categories, namely, infrastructure; resources; land use, urban geometry and morphology; governance; and socio-demographic aspects and human behaviour . Further analysis of these criteria showed that they provide various sustainability benefits (in terms of availability, accessibility, affordability, and acceptability), and can also enhance resilience abilities in terms of planning, absorption, recovery, and adaptation (Sharifi & Yamagata, 2016a).

Review of the extensive resilience literature also revealed that there are various qualities (principles) that should be met in order to appropriately achieve urban resilience. These qualities are namely, robustness, stability, flexibility, resourcefulness, coordination capacity, redundancy, diversity, foresight capacity, independence, interdependence, collaboration, agility, adaptability, self-organization, creativity, efficiency, and equity (Sharifi & Yamagata, 2016; Tyler & Moench, 2012). Possible linkages between these qualities with sustainability dimensions and resilience abilities have been explored (Sharifi & Yamagata, 2016). Figure 1 shows these linkages in a simplified way.

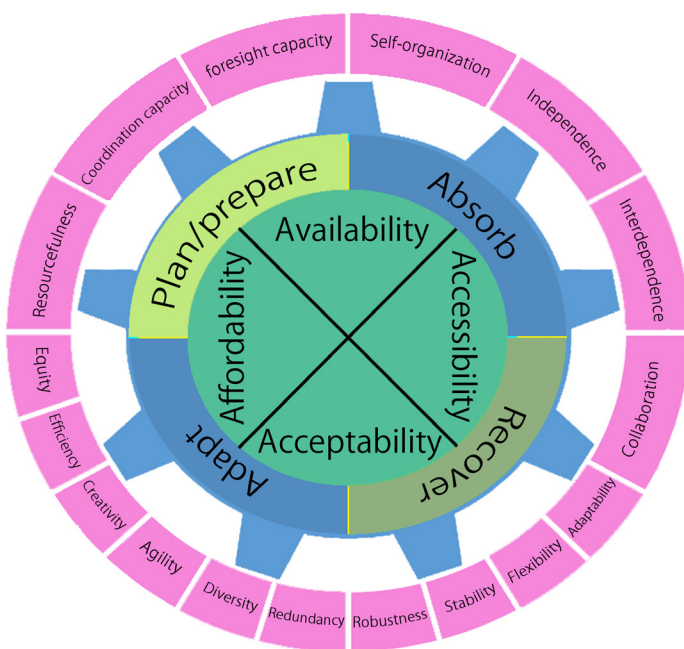


FIGURE 1. Different factors related to the assessment of urban energy resilience. Items of the pink band should be considered during planning, absorption, adaptation, and recovery phases in order to ensure availability, accessibility, acceptability, and affordability of urban energy. Adapted from Figure 2 in Sharifi and Yamagata (2016a).

3.2 Framework for evaluating suitability of urban resilience assessment tools

The evaluation framework includes six main criteria. These are briefly explained below; further information can be found in Sharifi (2016). ‘Comprehensiveness’, as the first criterion, implies that various resilience dimensions and criteria should be integrated into the assessment framework. ‘Cross-scale dynamism’ and ‘temporal dynamism’ are the next two evaluation criteria and should be considered in order to be able to track changes and influences over time and across space. The



FIGURE 2. Criteria for evaluation of resilience assessment tools (Adapted from Sharifi (2016)).

fourth criterion is related to addressing ‘uncertainties’ using methods such as modelling and scenario-making in the assessment process. According to the fifth evaluation criterion assessment tools should be developed and implemented through ‘participatory’ approaches that can enhance accuracy and applicability of the assessment results and provide learning opportunities for both citizens and local authorities. Finally, ‘action plans’ should be developed based on assessment results (Sharifi, 2016). These components are shown in Figure 2.

3.3 Examination of performance of the tools against the evaluation framework

Thirty six assessment tools were selected and evaluated using the framework displayed in Figure 2. In terms of comprehensiveness, it was found that more work is needed in order to provide a balanced account of different resilience dimensions. Analysed tools have, on average, paid more attention to the institutional dimension at the expense of other dimensions. As can be seen from Figure 3, it is particularly necessary to better acknowledge the significance of the environmental dimension (Sharifi, 2016). Average percentage distribution of the frequency of the criteria related to the five resilience dimensions is shown in Figure 3.

Results showed that assessment tools do not perform well in terms of reflecting cross-scale and temporal dynamism in their framework. Regarding the issue of scale, selected tools are mainly focused on the status quo of the focal scale. Community as the focal scale affects, and is affected, by other scales (upper and lower) and

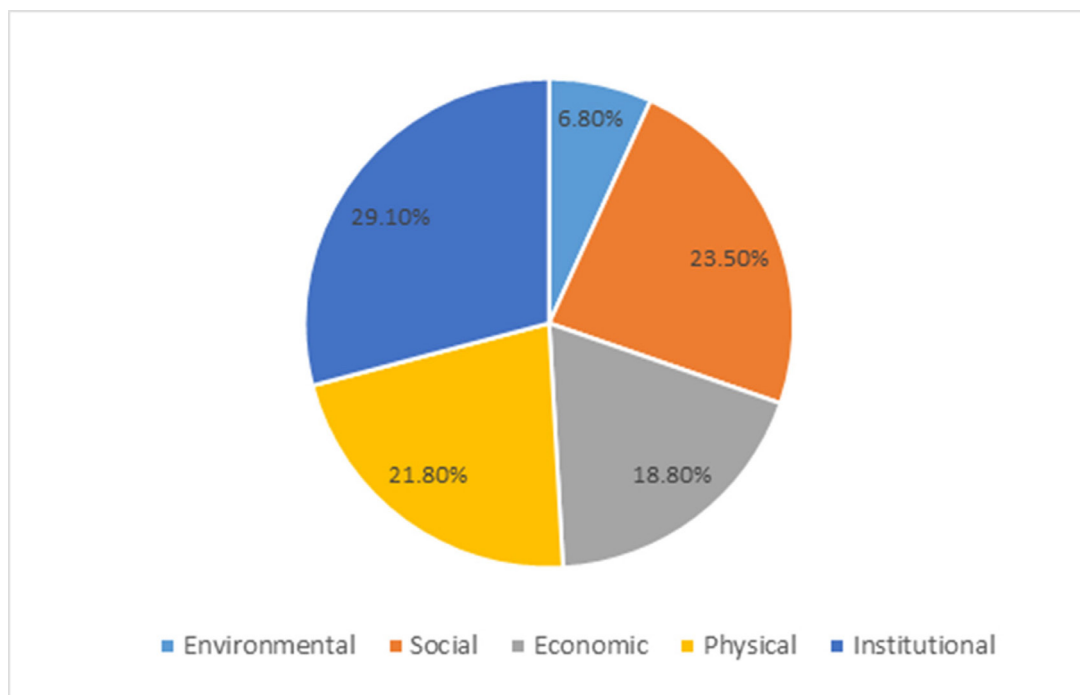


FIGURE 3. Average distribution of resilience criteria in selected community resilience assessment tools (Adapted from Sharifi (2016)).

this should be taken into account. Regarding the issue of temporal scale, assessment tools are mainly focused on the assessment of baseline conditions. In order to better address uncertainties, more work should be done with respect to developing alternative future scenarios, adopting an iterative approach, and utilizing modelling and simulation in the assessment process.

Limited success has been achieved in terms of taking participatory approaches (the fifth evaluation component). Further improvements are needed, particu-

adaptation, recovery, and sustainability?

3. What institutional elements contribute/detract from building resilience?

4. What would be the main challenges regarding development and implementation of assessment tools and integrating the results into the decision-making process?

Participants were divided into four groups as shown in Figure 4. The exercise provided an opportunity for participants from different related fields to share their



FIGURE 4. Participants were divided into four groups to take part in the activity designed based on the SIM technique.

larly regarding engaging stakeholders in the process of developing assessment tools. The same arguments apply to performance with respect to development and implementation of action plans (Sharifi, 2016).

3.4 Results of the SIM exercise

During the workshop the participants were asked to complete a checklist survey on the linkages between criteria related to urban form and resilience. The objective of the activity was to clarify how each criterion is related to different disruptive events such as flooding, hurricane, earthquake, drought, power outage, etc. It was also intended to calculate the relative importance of each criterion. This exercise helped participants engage in debates on issues such as synergies and trade-offs between the criteria. It was found that more time would be needed to complete the exercise. Therefore, further research on this topic is necessary in the future

The SIM session was centered on answering the following questions by the participants:

1. What elements of the built environment influence resilience and how is urbanization process related to resilience?
2. How is urban resilience framed in the context of

knowledge and learn from one another. The major points that emerged from this activity are briefly explained here. Regarding the elements of the built environment that are most related to resilience, participants listed many elements, including, robustness of the infrastructure, accessibility of facilities, urban typology and morphology, density, and street layout. It was discussed that other socio-economic issues should also be considered in addition to these physical elements. On the second question, it was emphasized that resilience, adaptation, recovery, and sustainability are interrelated concepts. Any resilience planning approach should pay attention to the interplay between these concepts. Also, potential synergies and trade-offs between these concepts need to be further investigated. Main themes with respect to governance and institutional elements included the necessity for a flexible system that features both bottom-up and top-down approaches, and the need for dealing with the issues of multi-level governance and interlinkages between different entities. Participants also emphasized the significance of transparency and accountability for resilience planning. The issue of trade-offs was again raised. Participants also mentioned the need for context-specific resilience planning and warned against developing general and prescriptive assessment tools.

In response to the last question, various challenges were identified. These include, but are not limited to, access and availability of data needed for resilience assessment, difficulties related to communication and dissemination of results, the boundary issues and multiplicity of factors that should be taken into account in order to define the optimal unit of analysis, and problems related to context-specificity and standardization of the assessment process.

4. CONCLUSION

Resilience is a topic of interest to planners and policy makers as they prepare to meet the consequences of climate change. This article reports on a research project focused on developing criteria and indicators for assessing various aspects of urban resilience. It was discussed that resilience is a multi-faceted concept and any effort to assess it should pay attention to environmental, social, economic, physical, and institutional dimensions. A framework for evaluation of resilience assessment tools was developed that emphasizes the significance of meeting six criteria: comprehensiveness, cross-scale dynamism, temporal dynamism, uncertainties, participation, and action planning. Evaluating selected tools using this framework showed that they are still far from being optimal.

The study also reported on activities that involved participation of researchers from different fields. It was emphasized that resilience assessment should fit the local needs and be capable of informing decision making process. The assessment process should enable a wide range of stakeholders to better understand the complexities of the urban system. This process should be appropriately integrated into the planning system. Such an integration will also be essential for implementation of assessment findings. The SIM activity proved very useful for facilitating discussions between participants with various backgrounds. It provided the participants with the opportunity to share their knowledge and experience.

This study emphasizes that further research is needed to gain better understanding of the synergies and trade-offs between various resilience criteria. It is also necessary to conduct more investigations on the relationship between resilience and related concepts such as vulnerability, mitigation, and sustainability.

ACKNOWLEDGEMENT

We would like to acknowledge the support from the Asia-Pacific Network for Global Change Research (APN), the National Institute for Environmental Studies, and the Urbanization and Global Environmental Change project. We would also like to thank the many individuals who

have contributed to this project.

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