RE-FRAMING EARTHQUAKE RESILIENCE
BRIDGING THE GAP BETWEEN THEORY AND IMPLEMENTATION

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In seismic prone countries, like Iran, the damages caused by strong earthquakes are so severe that the response to their impacts is often beyond the capacity of local governments (Shakib et al., 2011). Therefore, special attention should be paid to capacity building and increasing the preparedness for potential earthquakes. Improving resilience is one of the most significant approaches that can be addressed in this regard. The United Nations office for Disaster Risk Reduction (UNDRR), formerly known as UNISDR, (United Nations International Strategy for Disaster Reduction) (2017) defines resilience as the ability of a system or a society at risk to absorb the effects of crisis, resistance before collapse, and rapid reconstruction. During the last two decades the concept of resilience has gained much popularity in urban areas. However, there is still no unified classification on parameters of urban resilience (Scherzer et al., 2019). It is noteworthy that despite long decades of worthwhile researches in the field of disaster resilience, there are still a lot of unknown dimensions on this subject, especially regarding existing gaps between theories and implementation.

Moreover, there are many challenges concerning the lack of suitable resilience frameworks and models against the disasters, especially at local level in the developing countries. Referring to Mayunga (2007), without a framework in which criteria and indexes can be defined and assessed, the disaster resilience concept will not be practical for disaster risk reduction. Accordingly, as shown in Figure 1, in this study, a new theoretical framework is developed for evaluation of the resilience of neighborhoods against earthquake. It seems that the criteria introduced in theory (including robustness, redundancy, rapidity and resourcefulness) (Bruneau et al., 2003) are not sufficient and comprehensive at the neighborhood level for assessment of the resilience, while they can be considered as a basis for such analysis. Therefore, in order to evaluate resilience at neighborhood level, along with these criteria, other criteria such as flexibility, adaptability, diversity, concentration, density, enclosure, readability, regularity, balance, cooperation, and solidarity should be also considered in implementation.

Resilience is a dynamic process and city dynamics is a major challenge for evaluation of urban resilience; because primary indexes are based on static status (Moghadas et al., 2019). Moreover, urban resilience is a complex, nonlinear and multifaceted concept that is one of the challenges of resilience modeling in practice. In general, disaster resilience modeling is a challenging issue due to the complexity of dynamic characteristics (Platt, 2015). In addition to the urban dynamics and complexity, disaster resilience modeling seems to have other limitations such as problem with data availability and data processing shortcomings. Accordingly, in order to bridge between theory and implementation, this paper tries to develop a spiral model of earthquake resilience (Figure 2).

'Cost', 'capacity' and 'time' are three main elements of the spiral model of earthquake resilience. It appears that the priority of the resilience actions depends on cost-benefit analysis. Therefore, cost can be one of the components of the spiral model. Also, the 'functionality' and 'feasibility' of the actions depends on the capacity of each neighborhood. Consequently, capacity is considered as another model element. Furthermore, according to the existing literature and global experiences, time is one of the most significant resilience factors. The spiral model of resilience has numerous characteristics. This multi-level hybrid model consists of several successive layers and illustrates the progress of resilience. It starts with a goal and makes the neighborhood more resilient against earthquakes. It is noteworthy that the spiral model is a conceptual and

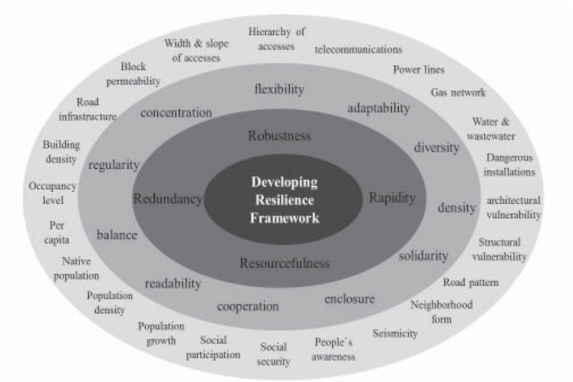

Figure 1. Re-framing earthquake resilience for implementation (source: the authors).

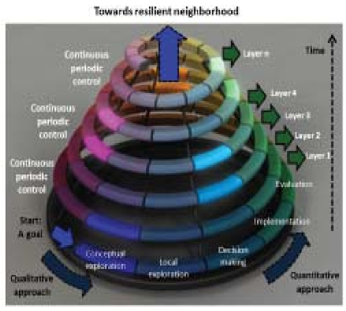

Figure 2. Spiral model of earthquake resilience (source: the authors).

operational model which is interactive and depends on mutual effects. Moreover, this stage model is a measurement tool which is dynamic and not static. It should be noted that this spiral model can be used for improving resilience as well as its evaluation.

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