Application of Crisis Management Principles in Earthquake-Stricken Urban Areas

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Human weakness and vulnerability to urban hazards are taken for granted. Human development has the tendency to move from villages towards the cities. In accident-prone countries, the consequences of crises are a major deterrent to development. The general effects of accidents include death and injury of individuals, damage to property, products, services, and infrastructure, and thus the impact on lifestyle and its social and psychological dimensions, from a doctrinal point of view, accidents, and disasters are part of the world of creation and divine test for awakening, and sometimes, the result of the actions and punishment of human sins and its occurrence causes the growth and excellence of human society. The disasters that have occurred in recent years indicate that societies and individuals have increasingly become vulnerable and that the risks have increased as well. About three-quarters of the world’s population lives in areas that in recent decades have experienced at least one of the four leading causes of death from crises: earthquakes, floods, storms, or droughts have experienced. In recent years, the occurrence of accidents and the number of injured people and the financial losses caused by them have increased significantly. Therefore, the main purpose of this article is to try to explain the components and constructive characteristics of resilience and determine the share of factors affecting resilience in crisis management in Tehran’s 15th district. Also, the results show that there is a significant level of 0.000 between resilience and the final situation. At the level of \( p = 0.01 \), then, this relationship is significant, the researcher’s hypothesis is confirmed with 99% confidence, and the null hypothesis will be rejected. The results show a linear relationship between the mentioned variable and social, economic, and physical resilience; that is, the results show that compliance with resilience indicators in natural disasters (earthquakes) can be effective in urban crisis managers.

1. Introduction

It is crystal clear that rapid urbanization and population growth are creating new challenges for human societies. In today’s world, where urbanization is increasing rapidly and, for the first time, more than 50% of the world’s population are city dwellers, urban hazards need to be addressed. More than one billion people live in slum areas, and their number is increasing day by day. This population, whose basic needs are not even met, is more exposed to natural hazards, including earthquakes. Urban hazards in the 21st century have created a major challenge for all humanity. Approximately three-fourths of the world’s population live in areas that have experienced, in recent decades, at least one of the four major causes of death from crises, namely floods, storms, earthquakes, or droughts [1]. The destructive potential of earthquakes depends on their magnitude and depth. Natural hazards around the world are also rising [2] and are becoming a bigger and more expensive threat, increasing the global economic cost associated with them [3]. Natural hazards turn into catastrophes when they affect vulnerable population groups [4]. Today, these events are considered as unsolved development problems [5]. Asia is considered to be the supermarket of incidents [6]. For example, in 2007, approximately 37% of the hazards reported occurred in Asia. This observation can be linked to a high degree of urbanization and poverty [7]. Earthquakes are the most devastating natural hazards around the world, and at the same
time, their potential damage has increased considerably [8]. The nonpreventive nature of earthquakes has transformed them into one of the deadliest natural hazards, as what occurred in India (2001), Pakistan (2005), China (2008), Japan (2011), and Iran (Arg-e Bam, Kerman, and East Azerbaijan) [9]. Reducing the risk of incidents is the current focus of disaster management by changing the paradigm from risk assessment to vulnerability and establishing a resilient society in line with the Hyogo Framework for Action 2005–2015 and the Sendai Framework for Disaster Risk Reduction 2015–2030 [10]. The urbanization of the world’s population leads to daily urban hazards.

UN Statistics Division (demographic and social statistics) has predicted that the majority of urban population growth will occur in urban areas in low-income or middle-income countries in the coming decades. Therefore, urban areas require particular attention because they are characterized by population concentration, housing and other buildings, transport infrastructure, and industrial infrastructure [11]. What occurs after an earthquake may lead to a crisis, depending on the severity and magnitude of the earthquake. McNeill and Ping [12] defined a crisis as an incident that creates psychological and social pressures and may occur at any time without any warning. Likewise, Harwati explained that a crisis is an unexpected incident that threatens the existence and functions of organizations [13]. Accordingly, this research investigates urban resilience to earthquake via a crisis management approach.

2. Literature Review

The reduction of risk and vulnerability is often neglected until after accidents [14]. In conditions where risks and uncertainties are growing, resilience is introduced as the concept of confrontation with disturbances, surprises, and changes. There are two types of strategies for facing incidents: prediction strategies and resilience strategies. The prediction strategies are adopted to encounter known problems, while the resilience strategies are used to cope with unknown problems. Explaining resilience to threats is, in point of fact, an understanding of how the social, economic, institutional, political, and administrative capacities as well as urban communities increase urban resilience and help identify its different dimensions [15].

Halling (1973) presented the concept of resilience in the field of ecology. However, different definitions of this concept have been presented in the domain of incidents, and the latest one is the definition offered by the United States National Academy of Sciences in 2012. It should be noted that the entry of the issue of resilience into the fields of urbanization and crisis management is a new cultural birth. Expressions such as resilient and sustainable societies, resilient lifestyles, and the creation of resilient societies are usually used in scientific papers and operational programs. Some believe that resilience is a new pattern in urban development, while others hold that it is similar to other terms of crisis management such as vulnerability reduction. Similar to other concepts of urbanization and crisis management, the concept of resilience has several dimensions, and no accepted common definition of it has been provided thus far. Although resilience has attracted particular attention in Iran and the world, a limited number of systematic rules of urban resilience have been presented so far. While there is a consensus on indicators that create vulnerabilities and those that improve community resilience, there is little consensus on how to measure them; over the past decade exclusively, comprehensive studies have been undertaken to develop vulnerability indicators [16]. Karl Folk et al. divided the resilience of socio-ecological systems into three different characteristics.

(i) The magnitude of the shock that a system can withstand and stay in a certain condition

(ii) The degree to which a system is capable of self-organizing

(iii) The degree to which a system can create adaptation and learning capacity [17]

A resilient city is a sustainable network of skeletal systems and human societies. Skeletal systems are built-up and natural components of the city and include roads, buildings, infrastructures, communications, and energy supply facilities as well as water routes, soil, topography, geography, and natural systems. In general, skeletal systems are similar to the body of a city, its bones, its arteries, and its muscles. A city without resilient skeletal systems will be very vulnerable to various incidents and changes. Human societies are the social and institutional components of a city. They include formal, informal, sustainable, and individual human communities that operate in a city environment: schools, neighbors, organizations, institutions, companies, and forces. Overall, societies act as the brain of the city, direct its activities, meet its needs, and use its experiences. During incidents and throughout history, human networks must remain and continue to function [16].

In 2017, Xuanhua et al. applied a method of reducing the set characteristic in order to remove inappropriate social vulnerabilities and optimize the proposed model. Finally, a disaster recovery method for social vulnerability to the earthquake was employed to overcome the social vulnerability index in vulnerability assessment. The use of the proposed method in the Sichuan province indicates large regional disparities in terms of social vulnerability to the earthquake. The results show that the northeastern and central areas of Sichuan Province belong to the group with high social vulnerability; in particular, Guangyuan is the most vulnerable area [18]. In his study, Morimoto provided information on the rehabilitation of urban transport and urban infrastructure in response to the Great East Japan earthquake. In particular, the knowledge of urban planning and transportation planning was used to help design physical programs [19]. Paolo et al. examined the impact of the L’Aquila earthquake (Italy) 2 years after the earthquake in a college campus. The analysis of the gender of those exposed to the danger indicated a significant interaction between men exposed to earthquake, whose scores of READ
factor were constantly higher. The solution to this problem showed a similar pattern for girls [20].

Ertugay et al. (2016) stated that one of the main goals of crisis management is to reduce the impacts of disasters by creating management plans and emergency management strategies. In this regard, modeling the access to emergency services such as health services, fire stations, security services, or earthquake shelters can be a valuable tool for disaster managers, especially in assessing vulnerabilities in urban areas as well as the extent and suitability of sites of emergency services. In these special studies, road closures are interconnected with ground fault, damage to bridges and passageways, and the collapse of buildings adjacent to the edges of roads. The method developed can provide managers and decision-makers with advanced and realistic support [21]. Bernardini et al. stated that the seismic risk assessment approach generally ignores human behaviors during an earthquake. Nevertheless, simulation of pedestrians' movement can be useful for introducing human interactions with postearthquake scenarios. Changes in the social force model have been presented to describe common behaviors. Simulation software has been designed to validate the model designed. Tests mainly include the speed and distance between people. This model can be integrated into various tools for analyzing possible choices in different scenarios and examining solutions to reduce environmental barriers during the discharge process [22]. Thejaswini et al. showed that further the effect of subsoil conditions where these buildings have been founded also plays an important role in the seismic response of these buildings [23].

Pagano et al. developed a systemic dynamic model (SDM) to assess the evolution of the resilience of the drinking water supply system to natural disasters, paying particular attention to the role of both structural and nonstructural parameters of reflections in a study in L’Aquila (Italy). The drinking water infrastructures were adversely affected during the 2009 earthquake, causing many limitations. In addition, rehousing citizens in temporary shelters led to a change in the demand pattern that needs to be adapted to the dynamics of infrastructure [24]. Eftekhar Ahmed [25] conducted a pilot project that was carried out in 2012–2013. He found that rapid urbanization and the growth of inequality in developing countries such as Bangladesh have led to an increase in slum areas as a solution to urban poverty problems. The project was undertaken as a study of the urban framework to identify the challenges and opportunities for creating resilience in poor neighborhoods and a series of related activities. It included training local experts in the concepts and uses of urban resilience, risk assessment tools, and action planning. Community-based participatory risk assessment (CBPRA) is designed to identify the risks and vulnerabilities of the Talab campus, which is carried out through an organizational survey at the urban level. Ezirim et al. declare many border communities are far from city centers and obscured from the mainstream of development [26]. A series of pilot activities are led by the planning workshops and public planning (CAP) via the creation of social capacities and social organizations. There are three main ways to address inadequate drainage activities, poor waste disposal, and poor sanitation and health [27]. Bhutani and Naval show that stability of infrastructure during an earthquake demands ground response analysis to be carried out for a particular region as the ground surface may suffer from amplified peak ground acceleration (PGA) as compared to bedrock PGA causing instability [28].

3. Material and Method

This nonexperimental study is a descriptive survey. Also, this research is based on the purpose of the applied type, and in terms of time, this research is cross-sectional. On the other hand, according to the type of information collection, this research is considered in the field of field research. In addition, a documentary or library method is used to study the sources to collect theoretical foundations. The data collection tool is a Likert questionnaire as well as a note from library resources.

3.1. Descriptive Statistics. This section presents methods for organizing, summarizing, and describing information such as age, gender, and education. The characteristics of the respondents in terms of gender from the total of 384 samples studied in this study are 51.56 (198%) men and 48.43 (186%) women. As can be seen, the proportion of men is slightly higher than women. Age range (31–35) has a high percentage, but the range of (26–30) has a relatively low percentage in the statistical population. The overall results show a high population density of respondents in the age group (31–35). Education rate from the total of 384 samples studied in this research is 37.5% bachelor and 14.6% diploma. Therefore, it can be concluded that the bachelor group has the highest frequency and the diploma and lower group has the lowest frequency. 44.27 (6% 10 years (maximum and minimum 11.98%) is more than 15 years.

3.2. Checking the Normality of the Indicators. First, the normality of the research indicators should be checked by a sample Kolmogorov–Smirnov test. The considered indexes has a normal distribution but Ho has no uniform distribution.

As shown in the data in Table 1, the significance level of the Kolmogorov–Smirnov test for all research indicators is greater than 0.05. As a result, all indicators studied in the present study have a normal distribution. distribution to examine the research indicators of the test parametric values.

3.3. Dimension: Social Resilience. Social resilience index has two subsets and is measured by 6 questions in the questionnaire. To evaluate the effect of the social resilience index against natural disasters such as earthquakes, a single-sample Student’s t test was used. The test results are given in Table 2. The researcher can divide the factors into 2 categories based on the test results. Factors: the calculated significance level is less than 0.05, and the confidence interval is in the range of positive numbers. These factors are
indicated by the symbol $H$ in the last column of Table 2. Ineffective factors: the calculated significance level is less than 0.05, and the confidence interval in the range of negative numbers is or the calculated significance level is greater than 0.05. In this case, the factor has a significant average equal to the average of 3, so it has no effect on improving the social resilience index in crisis management of natural disasters. These factors are indicated by the symbol $L$.

As can be seen from the data in Table 2, the significance level of the test for social resilience questions is less than 0.05 and the confidence interval of the questions is in the range of negative and positive numbers. Therefore, promoting and strengthening social resilience can have a positive effect on the city’s natural disaster crisis.

3.4. Dimension: Economic Resilience. The cultural and social being index was measured by 9 questions in the questionnaire. A one-sample t-test was used to examine the effect of economic resilience index in natural disaster crisis management considering. The test results are shown in Table 3.

As can be seen from the data in Table 3, the significance level of the test for all factors is less than 0.05, and the confidence interval of the questions is in the range of positive numbers. Therefore, the economic resilience index has a positive effect on crisis management in natural disasters.

Table 1: Kolmogorov–Smirnov test a sample of resilience indicators in crisis management.

<table>
<thead>
<tr>
<th>Test result</th>
<th>Significance level</th>
<th>Statistics K-S</th>
<th>Standard deviation</th>
<th>Average</th>
<th>Number</th>
<th>Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is normal</td>
<td>0.057</td>
<td>1.312</td>
<td>0.540</td>
<td>2.37</td>
<td>384</td>
<td>Social</td>
</tr>
<tr>
<td>It is normal</td>
<td>0.073</td>
<td>1.297</td>
<td>0.427</td>
<td>2.81</td>
<td>384</td>
<td>Economical</td>
</tr>
<tr>
<td>It is normal</td>
<td>0.081</td>
<td>1.267</td>
<td>0.397</td>
<td>2.37</td>
<td>384</td>
<td>Physical</td>
</tr>
</tbody>
</table>

Table 2: Results of Student’s $t$ test to investigate the effect of social resilience index on high urban crisis mortality.

<table>
<thead>
<tr>
<th>Test result</th>
<th>Assurance distance</th>
<th>95% Higher</th>
<th>Mean difference</th>
<th>Significance level</th>
<th>Statistical value $t$</th>
<th>Standard deviation</th>
<th>Average</th>
<th>Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.573</td>
<td>1.293</td>
<td>0.677</td>
<td>0.001</td>
<td>10.269</td>
<td>0.813</td>
<td>2.27</td>
<td>Question 1</td>
<td></td>
</tr>
<tr>
<td>1.582</td>
<td>1.370</td>
<td>0.026</td>
<td>0.001</td>
<td>0.084</td>
<td>0.715</td>
<td>2.30</td>
<td>Question 2</td>
<td></td>
</tr>
<tr>
<td>1.214</td>
<td>1.056</td>
<td>0.825</td>
<td>0.000</td>
<td>12.031</td>
<td>0.719</td>
<td>1.97</td>
<td>Question 3</td>
<td></td>
</tr>
<tr>
<td>1.489</td>
<td>1.147</td>
<td>0.518</td>
<td>0.001</td>
<td>11.947</td>
<td>0.812</td>
<td>2.14</td>
<td>Question 4</td>
<td></td>
</tr>
<tr>
<td>1.524</td>
<td>1.168</td>
<td>0.725</td>
<td>0.000</td>
<td>10.269</td>
<td>0.807</td>
<td>2.19</td>
<td>Question 5</td>
<td></td>
</tr>
<tr>
<td>1.325</td>
<td>1.057</td>
<td>0.627</td>
<td>0.000</td>
<td>11.324</td>
<td>0.824</td>
<td>2.46</td>
<td>Question 6</td>
<td></td>
</tr>
</tbody>
</table>

Table 3: Results of Student’s $t$ test to investigate the impact of economic resilience index on natural disaster crisis management.

<table>
<thead>
<tr>
<th>Test result</th>
<th>Assurance distance</th>
<th>95% Higher</th>
<th>Mean difference</th>
<th>Significance level</th>
<th>Statistical value $t$</th>
<th>Standard deviation</th>
<th>Average</th>
<th>Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.297</td>
<td>1.116</td>
<td>1.249</td>
<td>0.000</td>
<td>10.238</td>
<td>0.817</td>
<td>2.69</td>
<td>Question 7</td>
<td></td>
</tr>
<tr>
<td>1.346</td>
<td>1.197</td>
<td>1.072</td>
<td>0.003</td>
<td>11.297</td>
<td>0.837</td>
<td>2.36</td>
<td>Question 9</td>
<td></td>
</tr>
<tr>
<td>1.371</td>
<td>1.197</td>
<td>1.116</td>
<td>0.000</td>
<td>11.872</td>
<td>0.724</td>
<td>1.97</td>
<td>Question 10</td>
<td></td>
</tr>
<tr>
<td>1.429</td>
<td>1.112</td>
<td>1.278</td>
<td>0.000</td>
<td>11.251</td>
<td>0.774</td>
<td>2.24</td>
<td>Question 11</td>
<td></td>
</tr>
<tr>
<td>1.378</td>
<td>1.041</td>
<td>1.761</td>
<td>0.000</td>
<td>12.349</td>
<td>0.837</td>
<td>2.18</td>
<td>Question 12</td>
<td></td>
</tr>
<tr>
<td>1.302</td>
<td>1.003</td>
<td>1.581</td>
<td>0.001</td>
<td>10.347</td>
<td>0.721</td>
<td>2.01</td>
<td>Question 13</td>
<td></td>
</tr>
<tr>
<td>1.571</td>
<td>1.287</td>
<td>1.335</td>
<td>0.001</td>
<td>10.383</td>
<td>0.937</td>
<td>2.94</td>
<td>Question 14</td>
<td></td>
</tr>
<tr>
<td>1.352</td>
<td>1.179</td>
<td>1.317</td>
<td>0.001</td>
<td>11.072</td>
<td>0.903</td>
<td>2.67</td>
<td>Question 15</td>
<td></td>
</tr>
</tbody>
</table>

3.5. Dimension: Physical Resilience. Physical index was measured by 9 questions in the questionnaire.

As can be seen from the data in Table 4, the significance level of the test for all factors is less than 0.05, and the confidence interval of the questions is in the range of positive numbers. The information in Table 4 indicates that there is a positive and significant relationship between all independent variables and the dependent variable indirectly because the correlation coefficient is less than 1. The highest correlation coefficient between education and citizens’ behavior in natural disasters in the city is 0.344. It is obtained, and the lowest value is observed between age and citizenship, which means that with the increasing level of education and age, the incidence of citizens’ behavior tends to behave and deal properly with natural disasters (earthquakes). As independent variables increase, the dependent variable will also increase and vice versa as the independent variables decrease, the dependent variable also decreases as shown in Table 5.

The extracted results mentioned in Table 6 show that individual variables can affect the behavior of citizens. In the following, the relationship between regression and the effect of independent variables on the dependent variable is examined. Based on the analysis of Table 6, there is a regression relationship between individual variables and animal behavior in the natural disaster (earthquake) because $-p$ is less than 0.05 effective on research variables can be verified.
The results show that out of the 4 indicators that were examined (nature-oriented, social participation, civic behavior, and responsibility), the number obtained is lower than the average and indicates individualism and inactive and inadequate presence of citizens at the time. The consequences are the city’s inability against earthquakes and crisis management based on Table 7.

### 4. Discussion and Conclusion

Humans do not have the same power to respond to the disasters that threaten humanity today. For example, the deadly earthquake that killed more than 30,000 people, if it happened in Japan, would have no or very devastating effects. This amount of damage or degree of disaster response is called vulnerability. Many studies have been done in the world in relation to white crisis management, but, in Iran, no study with this concept has been done so far. Looking at disaster resilience as a planned process, including a set of measures or changes to strengthen the capacity of a disaster-stricken society when faced with shocks and pressures, emphasizes the central role of humans in the face of disasters. Therefore, disaster resilience can be considered as a quality, a characteristic with a result that is created by processes in society to strengthen the capacity to facilitate the response and recovery from disasters. In this regard, disaster management considers the process of human response to disasters, which consists of four stages: risk reduction, preparedness, response, and recovery as a rotation. The present paper tries to investigate the resilience situation in order to manage the crisis. The results show that compliance with resilience indicators in natural disasters (earthquakes) can be effective in urban crisis managers.

### Data Availability

Requests for access to these data should be made to the corresponding author (e-mail address: mah.rahimi@iauctb.ac.ir).

### Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

### References


