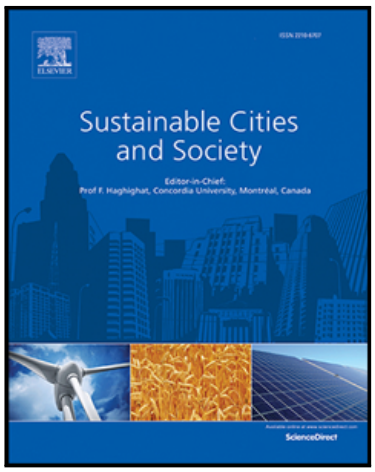

Evaluation of the principles and criteria of resilience in urban management (Case study: Qazvin)

Amer Nikpour , Mahdokht Ashoori

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Highlights

- Urban resilience improves through the knowledge and experiences of managers active in crisis management.
- Laws, infrastructures and education increase resilience in today's cities.
- Warning systems reduce damages from natural disasters by protecting natural resources.

Evaluation of the principles and criteria of resilience in urban management

(Case study: Qazvin)

1- Amer Nikpour

Title and institution: Associate Professor, Geography and Urban planning Department, College of social science, university of Mazandaran, Iran.

Address: Geography and Urban planning Department, College of social science, university of Mazandaran, Iran.

Telephone: +98-9111002343

Email: A.nikpour@umz.ac.ir

University of Mazandaran website: http://rms.umz.ac.ir/~nikpour/en/

Google scholar: https://scholar.google.com/citations?user=K_DOqXwAAAAJ

2- Mahdokht Ashoori (Corresponding author)

Title and institution: Master of Geography and Urban Planning, Faculty of Geographical Sciences and Planning, university of Isfahan, Iran.

Address: Faculty of Geographical Sciences and Planning, university of Isfahan, Iran.

Telephone: +98-9120430313

Email: Mahdokht.ashoori@gmail.com

Abstract

Resilience is a concept that has always been combined with urban sciences subjects by urban planners and has led to the creation of several theories related to urban resilience. Despite urban resilience being studied in different dimensions, its emergence in urban management as a practical step has been less attention. In this regard, this research has investigated resilience in urban management, and to achieve this goal, it has simultaneously considered the entire urban system from different aspects. What can be distinguished is considering the urban managers' and experts' perspectives who are active in crisis management. In this study, indicators framework were selected based on the reports of the UN-Habitat and the Rockefeller Foundation and Arup. Also, structural equation modelling with partial least squares approach has been used due to the complexity of the relationships between the factors. The output of this study can be used for cities with the same management structure and increase the awareness of urban planners and local managers to identify weaknesses and strengths in the direction of greater resilience.

Keywords: urban resilience, urban management, Structural Equation Modelling (SEM), Partial Least Squares (PLS).

1. Introduction

The cities are exposed to various concerns as highly population-concentrated areas (Zhu & Feng, 2019). For example, they suffer from unusual challenges related to climate change and rapid urban development, which cause a vulnerable environment against natural disasters (Zhu et al., 2020). In addition, these environments are sometimes confronted with events like changing demographics and old and new infrastructure and technologies (Marana et al., 2019). These circumstances and unsuitable development planning enhance

the exposure of cities to different kinds of disasters, which can generate new threats or worsen existing ones, enriching disaster-related losses. Therefore, cities must prepare themself proactively to mitigate these threats and create resilience to decrease the impact of disasters and recover as soon as possible (Saja, Goonetilleke & Ziyath, 2019). In this vein, resilience allows for more realistic anticipation of disasters and more reasonable planning to decline disaster losses (Brown & Williams, 2015). It could explain why resilience is intertwined with various urban issues and has led to the emergence of the urban resilience approach, which is one of the attractive topics among urban researchers.

However, evaluating resilience in the whole urban system has received less attention. Researchers have studied urban resilience for over two decades, but they have concentrated on a single part of urban issues (Sharifi, 2020), while urban systems are complicated and consist of interdependent subsystems (Rus, Kilar & Koren, 2018).

On the other hand, urban planners try to integrate fundamental urban issues into urban plans. Although, they do not majorly affect managerial functions because urban administrators do not transfer their knowledge to make an integrated and effective urban management plan (Chakrabarty, 2001). In contrast, local authorities require appropriate knowledge of the main factors affecting mitigation and adaptation methods to address threats (Sharifi & Yamagata, 2014) as they are primarily responsible for managing city disasters and their abilities and experiences in some situations are limited (Ishiwatari, 2021). Therefore, urban environments require a holistic view, considering their integrity, complexity, and significant change in resilience studies (Amaratunga et al., 2019). Recent studies have changed some perspectives and answered questions about resilience, such as what attributes should be measured. How can we learn about resilience through experiences, and how can these lead to integrated management (Brown & Williams, 2015).

Nevertheless, this research focuses on the principles and criteria of resilience in the urban system from managers' and urban experts' views who are active in crisis and urban management. This study can lead to an improved understanding of conditions (Allen et al., 2011) in urban management. The main question is, which factors are more effective in resilience urban management from urban managers' and experts' perspectives?

2. Literature review

2.1. Urban resilience and urban management

For the first time, the concept of resilience was used in ecology in 1973 by Holling. This term refers to a Latin word that means jump back (Xiao & Cao, 2017). The meaning of it has changed over time; first, it meant a bounce back, then moved towards prediction and capacity, but today is about bouncing forward (how to act better than past) (Weichselgartner & Kelman, 2014). This concept has been utilized in many fields (Ruiz-Martin, López-Paredes & Wainer, 2018). However, it is applied to urban studies intrinsically because of the root of essential research subjects in human ecology and creates the foundation of urban resilience theory (Ma et al., 2020). Urban resilience is about the ability of an urban system and its social and technical units to retrieve from crises and keep functioning (Mirzaee & Wang, 2020). It is not only about protecting cities more rationally and profoundly but also preparing them to face unexpected situations in the future. At the same time, cities learn from these circumstances, enhance their awareness, and improve urban managers' abilities to manage cities efficiently (Gao, 2019). It leads to a two-way relationship between urban resilience and urban management. Therefore, following a joint study of them requires considering two dimensions simultaneously. Firstly, the domino effect in urban systems. It means they are complicated and dynamic with compressed interlinked, which support each other in different scales. Whenever one part of these

systems fails causes effect disruptions to other parts (Chand, 2018). Secondly, the speed of changes in these systems is higher and finding practical solutions for their problems is difficult, particularly in developing cities (Masnavi, Gharai & Hajibandeh, 2019). It can be concluded that resilient urban systems need an integrated urban management system (Namjooyan & Sarvar, 2017).

In addition, two main theoretical perspectives on resilience, socio-ecological and engineering, should be combined. The socio-ecological standpoint concentrates on the process-oriented phenomenon of returning to the same state before the disaster happens. In comparison, engineering focuses on the result-oriented concept of responding, recovering and adapting (Rus, Kilar & Koren, 2018). Resilient management uses a more socio-ecological approach than engineering. It seeks to improve traditional risk management by adding adaptation and mitigation strategies (Elvas et al., 2021) because adaptations can increase the system's speedster to return to the normal state (Simonovic, 2016). Although resilience in urban management needs both perspectives because it has different social, organizational, economic, physical and environmental aspects, it should not only return to the state before the crisis but also respond, recover and adapt. "As the Japanese say, like bamboo, which bends under the weight of winter snow but stands tall again come springtime" (Van Der Vegt et al., 2015).

2.2. Urban management in Iran

Urban management is defined as a set of activities with a high level of interactions, and its goal is physical, economic and social development that leads to citizens' well-being (Alikhan, Mousakhani & Memarzadeh, 2014). Its definition in Iran has two aspects, content and procedural. The first part acts as policy, and the second focuses on the implementation dimension. Also, it is put at the level of local administration based on management levels in

Iran, including macro, regional and local (Zarei &Taghipour, 2017). Iran's urban management difference goes back to the executive and supervisory parts rather than in theory. According to the definitions, urban management in Iran is carried out by four agents: citizens, the Islamic city council, the municipality and the governor. Although in the stage of implementation and supervision, their authority and power are different. Urban management is a subset of local government and is part of municipalities and councils. These are types of local organizations, not independent local governments (Salari Sadroi & Kiani, 2018). There is a noticeable point: "Urban management in Iran has an all-around connection with the ruling political system of the country." Accordingly, its features, like open or closed, centralized or decentralized, are reflected in urban management, and its structure is the same for all cities (Saeednia, 2004; Kiani, Fazelniya & Salari Sardari, 2013). Generally, urban management in Iran has fluctuated in concept and structure. These fluctuations have strongly affected optimal control performance, especially in crises (Amiri & Mirzapour, 2018).

Based on this structure of urban management, various dimensions should be considered. For example, since managing urban affairs in Iran is the responsibility of different organizations, urban management resilience requires integrated and efficient management to avoid parallel work, rework and interference of executive bodies through organization and coordination. Another point is that urban management problems are not only caused by the lack, multiplicity or conflict of urban laws but also by other aspects that profoundly affect its conditions. Some of these aspects include a lack of coordination in planning and policy-making, the government authority in urban decisions and a lack of freedom of action of urban managers (Alikhan, Mousakhani & Memarzadeh, 2014; Kiani, Fazelniya & Salari Sardari, 2013). In addition to the problems in urban management, Iran's geographical and

geological conditions have made it one of the countries with high vulnerability to natural disasters. Based on reports, 37.7% of its area is exposed to natural disasters (Mahmodzadeh & Herishchian, 2018).

Accordingly, resilience in urban management in Iran's cities is vital for two reasons: the high risk of natural disasters in most cities and a similar structure for all cities. The second case (a similar system in all cities) has advantages and disadvantages; a successful example in one city can guide other cities well. However, ignoring local potential and conditions will be a drawback (Ardalan, Davoudpour & Ziari, 2020).

2.3. Background and indicators of resilience

Resilience has always been one of the famous concepts in urban sciences, and many studies have been conducted related to it. These studies investigated resilience from different perspectives and introduced various indicators. Although there are multifarious indicators, researchers in different fields choose them according to local conditions and their requirements (Eslamlou & Mirmoqtadai, 2017). For example, a review comprehensively analyzed resilience indicators in urban planning based on 43 climates, management, and economics articles. It classified resilience indicators into six main groups: infrastructure, security, environment, economy, institutions, society, and population (Sharifi & Yamagata, 2014). Another research conducted by Namjooyan and Sarvar in 2017 offered other indicators based on economic, social, institutional, and physical dimensions and particular approaches, including sustainability, recovery, and transformation. This study also considered global resilience experiences and proposed a resilience framework for managing future cities. According to the suggested framework, vulnerability results from the interaction between human systems and artificial and natural environments. Therefore, the identification of areas prone to natural hazards (natural environment), identification of

infrastructures and public arteries and vulnerable buildings (artificial environment) and urban management system (human system) are the fundamental indicators for assessing resilience. In addition, the influence of integrating urban management based on robust and efficient laws, the type of urban architecture, the participation and companionship of citizens and the use of past experiences are also significant.

Concerning the risk management perspective, a study was conducted on integrative disaster risk and resilience management in Iran, particularly Tehran and Karaj. This study concentrated on the knowledge of experts and presented some demands of disaster risk management in Iran. These demands not only focused on structure management and cooperation among all urban sectors but also considered risk assessment, monitoring and evaluation systems (Fekete et al., 2020). However, the closest study connected to resilience in urban management considered three physical, environmental and institutional aspects. The institutional dimension of this research summarised the ten essential factors for making cities resilient, proposed by UN-Habitat (Trends in Urban Resilience 2017) and the Rockefeller Foundation and Arup (Measuring City Resilience 2016). These factors included organization and coordination to understand and reduce disaster risk, assign a budget for disaster risk reduction, maintain up-to-date data on hazards and vulnerabilities, invest and maintain critical infrastructure, assess the safety of all schools and health facilities, realistic and risk-compliant building regulations and land use planning principles, education programmes and training on disaster risk reduction, protect ecosystems and natural buffers, install early warning systems, reconstruction measures (McGill, 2020).

Despite the common resilience indicators, newer indicators are recommended based on new findings. For instance, the ICLEI Committee for the Resilience Cities Program pointed out more minor indicators like private sector participation, cities' access to water and food

resources, and urban transportation (Bizzotto, Huseynova, & Estrada, 2019). Likewise, the mutual and complex relationship between resilient cities and smart cities in today's world and the critical role of technology in resilience indicators are noted (Zhu et al., 2020).

As mentioned above, many criteria exist for evaluating resilience from various perspectives. This study has considered the framework of ten indicators suggested by UN-Habitat, the Rockefeller Foundation, and Arup and then added some minor indicators from other resources, such as the effect of technology, cooperation with private sectors, organization between different urban domains and access to water and food resources. It is noticeable that these factors have been adjusted based on the case study's current information and limitations related to political and administrative issues. These indicators are shown in Table 1 according to latent and observed variables needed for the analysis part of the research.

Table 1
Indicators for assessing resilience

Latent Variables		Observed Variables	
A	Organization and Coordination	A1	The ability and capacity of urban managers and organizations regarding risk reduction in terms of knowledge, experience and laws
		A2	Partnership and cooperation between urban organizations
		A3	Contact between urban organizations and citizens
B	Budget and Financial Resources	B4	Allocation of funds for risk reduction programs from the central government
		B5	Monetization status of urban organizations and their ability to increase financial resources
		B6	Participation of the private sector in providing expenses, investments and support assistance
C	Updating Information	C7	Regular and periodic risk assessment status in urban programs
		C8	The status of information exchange related to risk trends and risk reduction measures between organizations and urban managers
		C9	Access to up-to-date technologies for collecting and classifying information
		C10	The facilities and readiness of urban organizations to update information at the time of crisis
D	Managing and Protection of Infrastructures	D11	The status of construction restrictions in the areas with high-risk potential
		D12	Land use policies and regulations/planning rules for infrastructures in urban plans
		D13	Supervised urban constructions (housing, schools, hospitals, etc.)
		D14	The state of existing facilities and public infrastructures in terms of location security

		D15	The status of necessary measures to protect public facilities and infrastructures against possible damages
E	Safe Schools and Hospitals	E16	The safety status of schools and hospitals against disasters
		E17	Evaluation of schools and hospitals in terms of maintenance, compliance with the principles of construction and safety in the programs of urban organizations
		E18	The capacity of training centers to transform into temporary treatment centers or temporary accommodations for the injured people
F	Construction and land use laws	F19	The existence of regulations related to the necessity of retreat and non-construction in the danger zones
		F20	Enforceability of regulations related to supporting disaster risk reduction
		F21	Effectiveness of fines for illegal construction
		F22	The effectiveness of incentive schemes, such as various types of loans for retrofitting and improving construction
		F23	Paying attention to the technical rules, principles and patterns of construction
		F24	Implementation of land use laws, construction and safety principles in construction activities
G	Education	G25	Training programs for urban managers
		G26	Educational programs related to disaster risk reduction in schools and universities
		G27	Educational programs for all citizens (regardless of social, economic or educational status)
		G28	The general state of citizens' awareness concerning necessary measures during the crisis
		G29	Using new technologies and social media to increase citizens' awareness related to disaster risk reduction
		G30	The status of educating citizens about disaster risk reduction by the private sector
H	Protection of Natural Resources	H31	Assessment of the current state of natural resources
		H32	Participation of citizens in the protection of natural resources
		H33	Participation of urban organizations in connection with the protection of natural resources
		H34	Preventing illegal constructions to protect natural resources
		H35	Access to essential resources by urban organizations in emergencies
I	Warning Systems	I36	Establishment of warning centers equipped with qualified facilities and expert human resources
		I37	Access of urban organizations to warning systems
		I38	Preparation of support factors related to warning systems, such as plans, supplies, shelter and evacuation routes
		I39	Forecasting and estimating disasters using advanced methods and technology
J	Rehabilitation Measures	J40	Consideration of rehabilitation measures in disaster risk reduction programs
		J41	Access to resources and trained individuals to help victims to reduce the psychological and social effects of disasters
		J42	The role of the private sector in supporting victims
		J43	The state of urban organizations' support for vulnerable people in society (such as the elderly and children)

Source: McGill, 2020; Bizzotto, Huseynova, & Estrada, 2019; Zhu et al., 2020; Fekete et al., 2020.

3. Methodology

Based on the literature on the subject, this research designed ten latent variables and 43 observed variables as a questionnaire. The statistical community is managers and experts from all urban organizations with experience in crisis management, especially one of the crisis committees. Concerning the statistical community, it is noticeable that the crisis management organization in Iran operates under the Ministry of Interior and has 13 specialized committees related to various crises, including the supply of fuel and petroleum materials, environmental hazards, technology, information, reconstruction, agricultural risks, earthquake risks, transportation, education, floods, security and regulations, health, housing and non-governmental organizations. At the provincial and local levels, crisis management is the responsibility of governors appointed by the Minister of Interior. Specialized committees are formed at local levels based on the needs of each province. Qazvin city has four fixed committees: Safety, fire fighting and rescue - Burial - Urban flood control - Warning and information. Thirty organizations that participate in these committees are indicated in Table 2. For other crises, specialized committees are formed from all related urban organizations to deal with matters when needed (Crisis management department in Qazvin municipality). To calculate sample size, we used the G power software with the following setting: f2=0.15 (medium), α= 0.05, and the number of predictors = 14 and the power was set at 90%; the sample size required to test proposed model is 166. In addition, we have considered the tenfold law related to the PLS method, which determines the sample size equal to 120. Consequently, 180 questionnaires were filled out by 30 individuals with experience in urban management and 154 crisis experts in urban organizations cooperating with crisis committees.

Table 2
Crisis committees in Qazvin city.

Committee	Urban organizations
Safety, firefighting and rescue	Fire department Municipality (Urban Planning/Technical and Civil Departments) Red crescent organization Emergency organization Organization of forests, pastures and irrigation Organization of engineering and building control system Road and urban development organization Organization of traditional gardens Traffic and transportation organization Organization of trade unions
Burial	Cemeteries organization Police Forensic medicine organization General department of Islamic advertising General civil registry office University of medical sciences Emergency organization Protection of environment organization
Urban flood control	Municipal services Waste organization Technical and Civil Deputy (Municipality) Water and sewage organization Agricultural Organization General Department of Planning and Irrigation Organization of traditional gardens Parks and green space organization Fire department Red Crescent
Warning and information	Crisis Management Headquarters Fire department Social Deputy (Cultural, Sports and Social Organization of the Municipality) public relations Red Crescent Broadcasting Organization Ministry of Education Meteorological Organization Police

Source: crisis management department in Qazvin municipality.

4. Study area

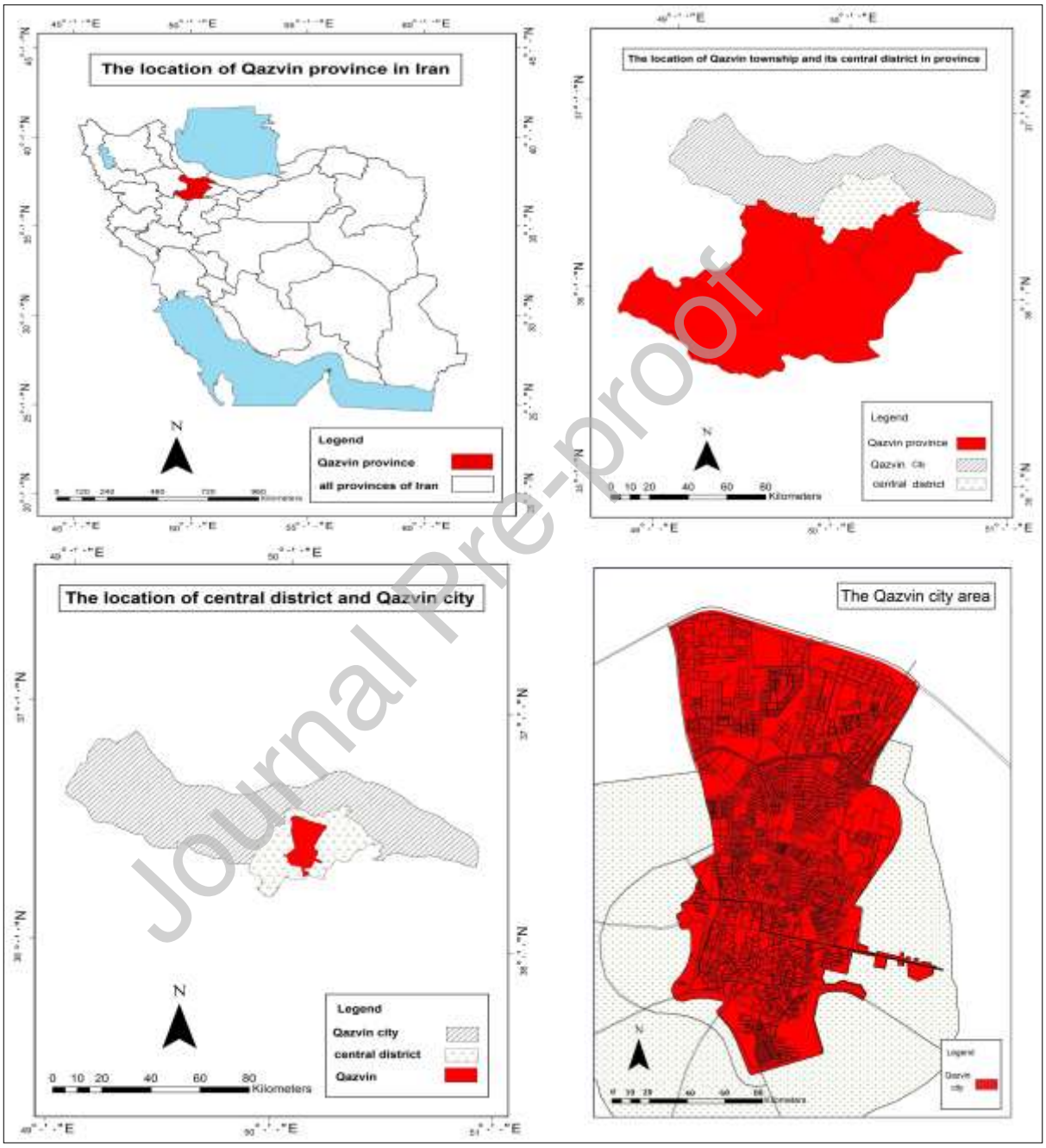
The city of Qazvin is the capital of Qazvin province in the central part of Iran, which borders Mazandaran and Gilan provinces from the north, Hamedan and Zanjan provinces from the west, Markazi province from the south, and Tehran province from the east. This province is divided into five cities. Qazvin is known as the centre of Qazvin City (Nasserzadeh & Ahmadi, 2013). In Fig. 1, the location of this city is shown on the national and provincial maps. This city is significant among the country's cities because it bridges its northern and southern provinces and is considered an industrial hub with 11 industrial towns.

Furthermore, due to the significant growth of urban spaces and the existence of railways and large academic centres, it has always been a destination for immigrants from other cities and provinces. Therefore, its urban population has continuously increased during the country's official censuses. In addition to the industrial importance and the increasing trend of the urban population, Qazvin is considered one of the country's historical cities. This city was the capital of Iran during the rule of the Safavi dynasty for 57 years, and for this reason, it has many monumental buildings (Emamjomeh, Nikpay & Safari Variani, 2011; Nasiri Hind Khale, Osanlu & Chitgar, 2013). These existing conditions and the history of natural disasters in Qazvin province increase the need to examine the resilience of urban management in this city. According to the latest Qazvin crisis management assessments, 74 cities and villages are at risk of flooding, including 17 cities and 54 villages. Also, Qazvin is one of the earthquake-prone provinces of the country and experienced one of the most disastrous earthquakes in the country in 1962 in Buin Zahra. This earthquake destroyed 91 villages and caused 12,200 death. A recent study on the northern Qazvin fault showed that if this fault is activated in the worst possible case, it can lead to an earthquake with a magnitude of 7 on the Richter scale in the scale of internal waves, leading to catastrophic human and financial

losses. This fault has not been active for more than 700 years, increasing these concerns (Crisis Management Organization of Qazvin Province, 2021).

Eventually, the possibility of natural disasters is not the only circumstance that managers have been struggling with it but also, according to the three-year performance report of Qazvin municipality (2009-2011), incidents such as fires, collapses, accidents, and other types of man-made disasters are the concern of urban managers for more efficient management (Hadad, 2016).

Fig.1. The location of Qazvin in the national and provincial maps (source: Qazvin municipality).

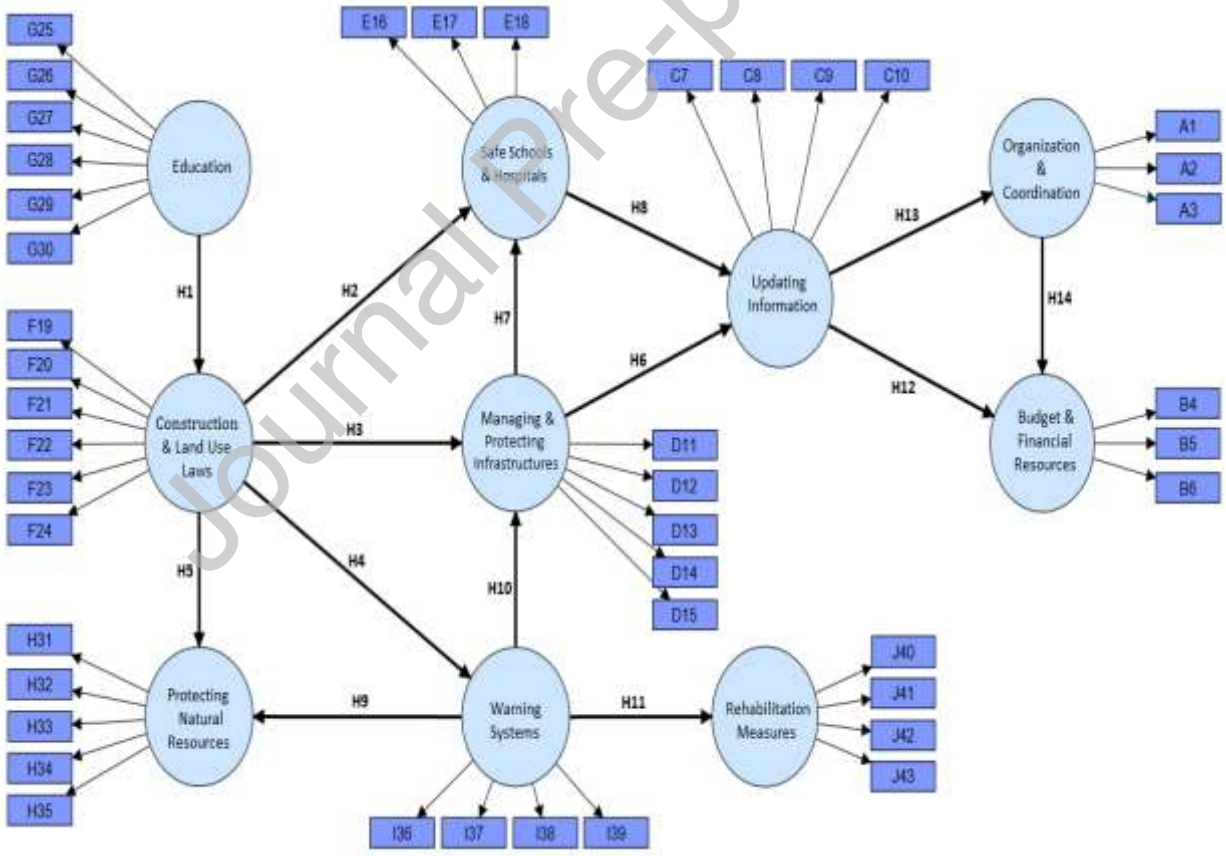


5. Results and discussion

5.1. Proposed model

SEM has two types: covariance-based and variance-based (Afshani, Nouriyan & Pahlevansharif, 2019). This research has been conducted through variance-based (VB-SEM), called PLS. This technique begins with a graphical description of the proposed model. Fig. 2 is a graphic description which indicates the proposed model of relationships between urban resilience factors which have effect on urban management directly or indirectly. This model illustrates latent variables through circles and observed variables through rectangles, and assumed arrows indicate relationships between them (Calvo-Mora et al., 2015).

Fig.2. Graphical description of the proposed model.



The assumed relationships in the proposed model based on the subject literature are as follows:

Given that social resilience is a significant part of the resilience process in cities and education plays a vital role in this way, a study has pointed out the effect of knowledge on crises. According to this study, the quality and quantity of education concerning disasters profoundly impact controlling the situation at the time of need. This factor can influence all three stages of a crisis (before, during and after). In the pre-crisis phase, if training increases, it can affect existing laws regarding higher officials' enforcement and citizens' compliance. In addition, during the crisis stage and after that, it leads to better control of the situation and more cooperation between injured, rescuers and officials and prevents chain problems (Keikha et al., 2018). Based on the concepts of resilience in urban management, the effect of training in the pre-crisis stage is considered in the proposed model. Thus, there seems to be a relationship between education and construction and land use laws.

H1= Education (E) ➟ Construction and Land use Laws (CLL)

Environmental resilience has a complex relationship with social and economic resilience, and it is affected by human activities and existing laws. Environmental conditions can reduce vulnerability and increase resilience, especially against natural disasters. Thus, laws can act as a protective shield and prevent more problems (Gankhaki, Taghvaei & Bardestani, 2020). In this vein, it seems laws can affect the protection of natural resources.

Furthermore, the factor of laws is also significant from the point of view of urban managers because one of their concerns is worn-out structures. These areas are very vulnerable to all kinds of disasters and strongly impact crisis management in the entire city. Old and vulnerable infrastructures are the most significant problem in these areas, and laws can help to change them (Monavvarian, Amiry & Mehrikoli, 2018). Consequently, it seems that laws impact the management and protection of urban infrastructure. Based on the factors

considered in the proposed model, safe schools and hospitals, as well as warning systems, can be regarded as a type of urban infrastructure, and the impact of laws on them can be considered as related hypotheses.

H2= Construction and land use laws (CLL) ➟ Safe Schools and Hospitals (SSH)

H3= Construction and land use laws (CLL) ➟ Managing and Protecting Infrastructure (MPI)

H4= Construction and land use laws (CLL) ➟ Warning Systems (WS)

H5= Construction and land use laws (CLL) ➟ Protecting Natural Resources (PNR)

From the physical resilience perspective, all types of infrastructure related to water networks, electricity, gas, access to medical centres, fire departments, temporary accommodation, police, road network and emergency centres can influence crisis conditions (Karimi & Jalilisadrabad, 2020). These infrastructures' quality is also one factor that protects cities against risks, as the continuity of services in critical conditions is related to the state of the infrastructures. Actually, it dramatically impacts water supply, power distribution, solid waste management, and the transportation systems that enable the flow of goods, services, people, and information. Moreover, the role of flexible infrastructures in urban resilience is significant as critical services within the city are supported by diverse and influential infrastructure, which had been appropriately planned and delivered (Index, 2014).

As a result, urban infrastructure seems to significantly impact the flow of information as an essential factor in the resilience of urban management. Also, it seems that safe schools and hospitals, which can be used as aid bases in times of crisis, are affected by urban infrastructure and are considered a kind of flexible infrastructure. Finally, they seem also to affect the flow of information and services separately.

H6= Managing and Protecting Infrastructures (MPI) ➟ Updating Information (UI)

H7= Managing and Protecting Infrastructures (MPI) ➟ Safe Schools and Hospitals (SSH)

H8= Safe Schools and Hospitals (SSH) ➟ Updating Information (UI)

Warning systems are very effective in resilience, especially against natural disasters like earthquake warning systems (EEW) launched in Japan in 2007. Although they have some disadvantages, such as false warnings, and insufficient accuracy, they are significant in helping people in crisis. For example, in the Tohoku earthquake in 2011, more than 80% of people in the districts of severe seismic shocks used the EEW, which positively impacted saving them and their families (Fujinawa, Kouda & Noda, 2015). In this vein, warning systems can help the people involved in crises and, in connection with small-scale disasters, can help the authorities strengthen the environmental conditions and protect urban infrastructures against large-scale crises (Norouzi, Ghavasieh & Attari, 2009). In addition, as part of a more extensive system, these systems can effectively change the management process with timely detection and warning, which improves relief and rehabilitation measures before and after the crisis (Taheri Kalani, Latif Shabgahi & Alyari Shooredeli, 2019).

Therefore, it seems that based on the desired parameters in the proposed model, warning systems can affect the protection of natural resources, the protection and management of urban infrastructure, and rehabilitation measures.

H9= Warning Systems (WS) ➟ Protecting Natural Resources (PNR)

H10= Warning Systems (WS) ➟ Managing and Protecting Infrastructures (MPI)

H11= Warning Systems (WS) ➟ Rehabilitation Measures (RM)

From the institutional dimension of resilience, leadership, financial and information resources, optimization, and cooperation between different organizations can be remarkable (Ardalan, Davoudpour & Ziari, 2020) as resilience has a special relationship with contemporary cities' key goals, including sustainability, governance and economic

development. While information and resources profoundly impact this relationship and act as signals transmitting in complex urban systems, which increase the systems' capacity (Desouza & Flanery, 2013). Hence, different resources can have a meaningful relationship with information, significantly regarding the smart city. Also, concerning management systems in times of crisis, an appropriate and flexible information infrastructure can effectively maintain organizational tasks. Information networks and a clear flow of information lead to more coordination in management (Kapucu, 2012). As a result, it seems that information can affect financial resources, organization, and participation.

H12= Updating Information (UI) ➟ Budget and Financial Resources (BFR)

H13= Updating Information (UI) ➟ Organization and Coordination (OC)

From a managerial point of view, coordination is an essential element that affects the organization and planning process at different stages. Coordination before the crisis helps in better planning and identification of weak points. Also, during the crisis stage, it leads to better services and prevents the wastage of resources, especially financial resources (Bazregar et al., 2013). Moreover, directing organizational activities requires using resources and expenses; without these factors, no goal can be achieved, and no management can be applied. In this regard, planning is at the top of management duties. It organizes the need for facilities and resources to meet the shortages. On the one hand, financial resources and organizational budgets and, on the other hand, elements such as organization and coordination affect the management process (Madani, 1992). Thus, there seems to be a relationship between financial resources and organization and coordination.

H14= Organization and Coordination (OC) ➟ Budget and Financial Resources (BFR)

5.2. Model analysis

In the following phase, "The PLS method consists of two stages; structural (internal) and measurement (external) models". The measurement model evaluates the relationships between latent variables and their indicators, but the structural model assesses the latent variables' relationships (Roldán & Sánchez-Franco, 2012; Calvo-Mora et al., 2015).

5.2.1. Measurement model

Considering that the proposed model is reflective, in the first step, its assessment has to be based on reliability and validity (Sadeghpour & Mouradi, 2018).

Table 3 depicts Cronbach's alpha, indicators loadings and composite reliability exceeding the 0.7 thresholds. It confirms internal consistency and higher support homogeneity of the indicators, meaning all constructs are well measured by their assigned indicators. Therefore, indicators and dimensions are reliable. In association with the convergent validity, all constructs' average variance extracted (AVE) values greater than 0.5. It guarantees that indicators are not assigned to the wrong latent variables.

Table 3
Construct reliability and validity

Construct/indicator	Loadings	Cronbach's alpha	Composite reliability	AVE
Organization and coordination		0.845	0.907	0.765
A1	0.900			
A2	0.917			
A3	0.803			
Budget and financial resources		0.758	0.859	0.671
B4	0.873			
B5	0.847			
B6	0.731			
Updating information		0.885	0.920	0.743
C7	0.824			
C8	0.888			
C9	0.887			
C10	0.847			
Managing infrastructures		0.911	0.934	0.738
D11	0.851			

D12	0.883			
D13	0.794			
D14	0.908			
D15	0.856			
Safe schools and hospitals		0.855	0.913	0.777
E16	0.815			
E17	0.911			
E18	0.915			
Construction and land use laws		0.934	0.948	0.752
F19	0.812			
F20	0.902			
F21	0.817			
F22	0.880			
F23	0.888			
F24	0.901			
Education		0.915	0.932	0.697
G25	0.797			
G26	0.806			
G27	0.862			
G28	0.878			
G29	0.821			
G30	0.842			
Protection of Natural Resources		0.884	0.915	0.684
H31	0.762			
H32	0.799			
H33	0.856			
H34	0.873			
H35	0.841			
Warning Systems		0.881	0.919	0.741
I36	0.892			
I37	0.901			
I38	0.896			
I39	0.744			
Rehabilitation Measures		0.909	0.937	0.787
J40	0.833			
J41	0.933			
J42	0.916			
J43	0.863			

In addition, the discriminant validity is shown in Table 4. The numbers on the table diagonal indicate the square root of the AVE for each latent variable, which is more significant than their correlation with any other latent variable. Consequently, the main structures of this model interact more with their indicators than with other structures.

Table 4
Discriminant validity

	Budget	Construction Laws	Education	Natural Resources	Organization	Rehabilitation	Safe Schools and Hospital	Warning Systems	Information	Infrastructure
Budget	**0.819**									
Construction & Land use laws	0.361	**0.867**								
Education	0.264	0.581	**0.835**							
Natural resources	0.354	0.664	0.443	**0.827**						
Organization & Coordination	0.502	0.352	0.236	0.361	**0.875**					
Rehabilitation measures	0.336	0.573	0.403	0.630	0.281	**0.887**				
Safe schools & hospitals	0.375	0.784	0.450	0.597	0.354	0.518	**0.882**			
Warning systems	0.346	0.603	0.377	0.690	0.302	0.718	0.590	**0.861**		
Updating information	0.484	0.526	0.363	0.503	0.425	0.391	0.642	0.453	**0.862**	
Managing infrastructure	0.321	0.632	0.470	0.496	0.317	0.421	0.712	0.537	0.688	**0.859**

5.2.2. Structural model

The most important indicators for evaluating the model's structural (internal) part in the PLS method include R2, F2 and Q2 indexes. R2 explains the variance in the endogenous variable through the exogenous variables. Therefore, this value is present only for the model's endogenous variables, and in the case of exogenous constructs, its value is equal to zero (Sadeghpour & Mouradi, 2018). In our proposed model, only education is an exogenous variable, and the rest are endogenous. In addition, according to Chin (1998), R2 values are considered to be 0.67, 0.33, and 0.19 as substantial, moderate, and weak, respectively. Based on the results in Table 5, all variables in the proposed model are at a moderate level. However, the variable of organization and coordination is at the weak and safe schools and hospitals variable put in a substantial group.

The predictive relevance of the structural model evaluates through the cross-validated redundancy index (Q2) (Calvo-Mora et al., 2015). This criterion, introduced by Stone and Geiser, determines the model's predictive power in endogenous constructs. According to

their belief, models with an acceptable structural fit should be able to predict the model's endogenous variables. It means that if the relationships between the structures are correctly defined in a model, the structures have a sufficient impact on each other. In this way, the hypotheses are correctly confirmed. If the value of the Q2 index is positive, it indicates that the model's fit is favourable and has good predictive power (Hensler et al., 2009). Based on Table 5, all the Q2 values in the proposed model display values positive and above zero; thus, it can be concluded that the model has predictive relevance.

Table 5
R2 & Q2

	R 2	Q2
Budget	0.341	0.218
Construction & Land use laws	0.338	0.251
Natural resources	0.574	0.385
Organization & Coordination	0.181	0.127
Rehabilitation measures	0.516	0.397
Safe schools & hospitals	0.693	0.529
Warning systems	0.363	0.264
Updating information	0.520	0.381
Managing infrastructure	0.438	0.316
Education	-	-

The last index of the structural part of the model is F2. This index demonstrates the change in R2 when the exogenous variable is removed from the model. In fact, it is for independent variables and shows the portion of changes in the estimate of the dependent variable when the effect of that variable is removed (Sadeghpour & Mouradi, 2018). According to Cohen (1988), the value of this index illustrates changes of 0.02 (weak), 0.15 (moderate) and 0.35 (strong). Based on the results in Table 6, this index has obtained the highest value in the relationship between warning systems on rehabilitation measures. In contrast, its lowest value in the proposed model relates to the same variable and infrastructure management.

In the last part of the structural model review, the Bootstrap technique was used to evaluate the proposed hypotheses in the suggested model, which presents the standard error and the t values of the parameters (Calvo-Mora et al., 2015). This test's path coefficient will be significant if the T-statistic is larger than 1.96 (Wong, 2013). Actually, this technique demonstrates the importance of the structural paths and the hypotheses' support or lack of support; according to Table 6 and Fig. 3, all hypotheses proposed in the model are above 1.96; therefore, it can be concluded that the hypothesized relationships in the structural model are confirmed. Also, the direct, indirect and total path coefficients are shown separately, indicating the different variables' impact.

Table 6
Path coefficient, F2 & t-statistic

Relationship	Direct	Indirect	Total effect	F2	T-statistic	P-value	Hypothesis-test
E ➡ CLL	0.581	-	0.581	0.510	12.355	0.000	**H1** Accepted
CLL ➡ SSH	0.556	0.228	0.784	0.604	10.847	0.000	**H2** Accepted
CLL ➡ MPI	0.485	0.147	0.632	0.267	6.981	0.000	**H3** Accepted
CLL ➡ WS	0.603	-	0.603	0.571	12.515	0.000	**H4** Accepted
CLL ➡ PNR	0.390	0.275	0.664	0.227	5.926	0.000	**H5** Accepted
MPI ➡ UI	0.470	0.111	0.581	0.227	7.052	0.000	**H6** Accepted
MPI ➡ SSH	0.361	-	0.361	0.255	6.473	0.000	**H7** Accepted
SSH ➡ UI	0.307	-	0.307	0.097	4.743	0.000	**H8** Accepted
WS ➡ PNR	0.455	-	0.455	0.310	6.983	0.000	**H9** Accepted
WS ➡ MPI	0.244	-	0.244	0.067	3.350	0.000	**H10** Accepted
WS ➡ RM	0.718	-	0.718	1.064	19.778	0.000	**H11** Accepted
UI ➡ BFR	0.330	0.154	0.484	0.135	4.903	0.000	**H12** Accepted
UI ➡ OC	0.425	-	0.425	0.220	6.775	0.000	**H13** Accepted
OC ➡ BFR	0.362	-	0.362	0.163	5.286	0.000	**H14** Accepted

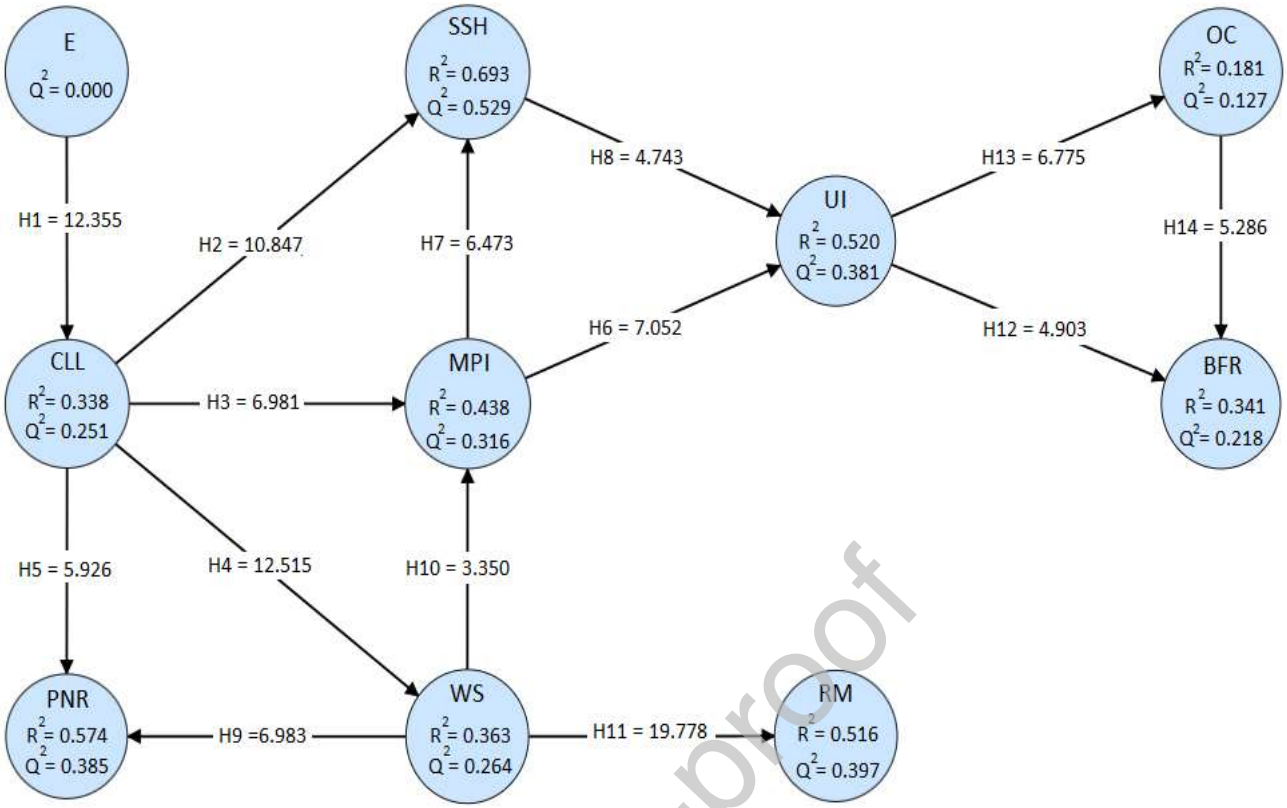


Fig.3. Structural model results.

6. Conclusion

Resilience in urban sciences has always been studied from one part of physical, social, economic, environmental or institutional aspects. The study of this concept by considering all the dimensions simultaneously and from the point of view of urban managers and experts has been given less attention if these individuals profoundly impact guiding and controlling the factors in urban resilience and their experiences can be beneficial in future city planning, especially in terms of crisis planning.

In addition, the complexity of urban and management systems requires an integrated study that considers both systems at the same time and shows the impact of different factors on each other. This research has considered urban resilience factors, management structure, resilience aspects, and professional experiences to fill this gap.

Based on the obtained results, construction and land use laws, urban infrastructures, and warning systems are three powerful and influential factors in the resilience cycle of urban management. Improving their quality and quantity can be decisive in managing city crises as, in the first step, the construction and land use laws protect the framework of the cities as a central pillar and affect the urban infrastructure, including safe schools, hospitals, and warning systems. In continuing this resilience, especially during the crisis, the urban infrastructures improve the management and make it easier to control the situation. Of course, elements such as education, information flow, financial resources, coordination and organization affect different parts of this system and help to improve conditions in all three stages of the crisis from different perspectives.

These outcomes show that urban laws are at the top of the urban management resilience pyramid, and this point can benefit cities with a management system similar to the city studied in this research. However, the local characteristics of cities have to be considered.

Moreover, Examining the existing urban laws, establishing new laws based on the current needs of each city, as well as pressure and monitoring their implementation, will improve resilience in urban management. The noteworthy point is that education at different levels of society can strongly influence this vital factor. Therefore, holding training courses for urban managers and different social groups can contribute to solid urban laws.

On the other hand, urban infrastructures play an assertive role in the resilience of urban management. It can improve the speed of returning to the initial state and managing crisis conditions while reducing human and financial losses during a crisis. Thus, the protection and management of urban infrastructures in different cities, especially metropolises, should be prioritized in the plans of urban managers.

Ultimately, despite the existing limitations in urban management in terms of political conditions and administrative laws, researchers can focus more on urban laws that affect the resilience of urban management to determine its strengths and weaknesses.

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