Shocks, hazard risk management and resilience from an institutional outlook: what lessons for a (smart) city?

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Abstract

As a result of various shocks and natural disasters, the scientific community has expressed a particular interest in the study of countries resilience capacity, after being affected by a hazard. In association with this concern, hazard risk management is becoming a relevant and highly debated topic, due to an increased exposure of people to devastating disasters, all around the world. In the context of fighting for the mitigation of threatening manifestations of nature, the paper provides an overview of hazard risks and resilience, from an institutional perspective, underlying the main characteristics and lessons that can be learned by smaller administrative units (cities) from the emergence of some shocks. In recent years, European Union policies have focused on the component of (smart) city resilience to fatidic events, which has led us to further highlight the major elements that should define it, in order to minimize as much as possible the negative effects of hazards.

Keywords: shocks, resilience, institutions, hazard risk management, (smart) city policies

Introduction

Confronting the current intensive urbanization process and the features associated with this context, the world should prepare for an urban planning transformation and a management that integrates innovation and technologies like "Internet of Things - IoT" (Jayavardhana *et al*., 2013), in changing stages, from traditional cities to smart cities (Nilssen, 2019; Opdyke *et al*., 2017; Allam and Newman, 2018). The new challenge is based on data processing and management, incorporating a new decision management mechanism and various systems (physical, digital, etc.) for a future sustainable development.

Hazard risk management and resilience are issues that cities, particularly those of developing countries, should put them at the forefront of policymakers' discussions. Currently, these are topics of high interest in public discourse, due to a growing exposure of people worldwide to devastating natural disasters, demonstrating the unpredictable and intense force of nature. Recent intense hazard

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risk manifestations brought changes in urban developments, so that the research activity towards smart cities has become a priority for political entities, practitioners and scientific community. International statistics show a dramatic multiplication of hazard risks and, at the same time, they draw attention to the fact that in the period 1975-2015, the population living in seismic areas increased by 93% (European Commission, 2017, p. 6). Hazards integrate one of these categories: atmospheric, hydrologic, geologic, biologic, technologic, putting under risk people, buildings, environment, facilities, production and economic activities (Bourdeau-Brien and Kryzanowski, 2020; Kappes *et al*., 2012). Statistically, the consequences of these hazards are quantified in deaths and injuries, economic losses or number of constructions destroyed (McCaughey *et al*., 2018; Saja *et al*., 2018; Mebarki *et al*., 2016; Vrouwenvelder *et al*., 2012; Paton and Johnston, 2001; Kreimer, 2001). In fact, the impact is more significant, containing complementary aspects like social impact, immeasurable environmental impact and so on. The distribution in time and the intensity of hazards around the world is inequitable, certain territories being more affected than others.

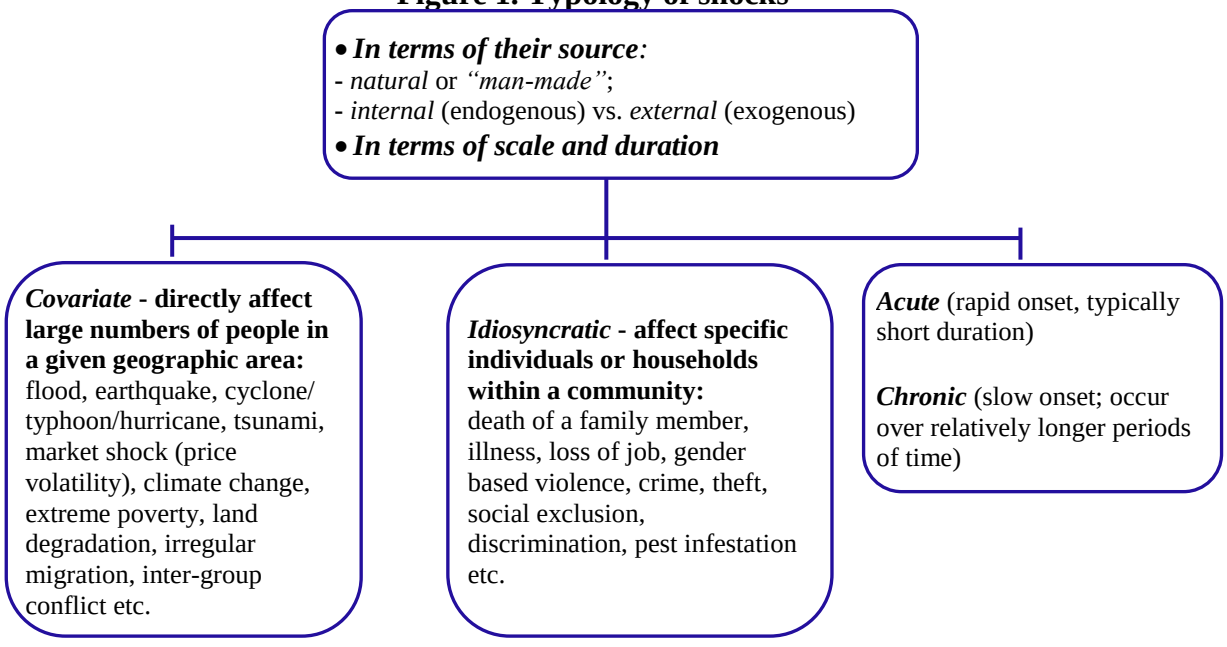
The management of hazards, consisting of an optimal plan for decision making, is responsible for the resilience or, at the opposite, for the vulnerability of a city, and can influence the scale of a disaster impact. The states differ in their degree of adjusting to disturbances from the external, economic, politic, cultural environment, according to their resilience capacity. Countries that are confronting high frequency and intensity of hazards, such as USA or Japan, have reconfigured their strategies and policies in disaster management, invested significant resources to reduce the consequences of hazards (Liu *et al*., 2013; Chang and Shinozuka, 2004; Klein *et al*., 2003). In the same trend, the European Union (EU) created joint strategies and action plans with other regional or country groups. An example is Hyogo Framework for Action: "Managing risks to achieve resilience", covering a plan on "Building the resilience of nations and communities to disasters" (European Commission, 2014; United Nations Office for Disaster Risk Reduction, 2007).

By reference to technologically, innovative and complex administration of urban life, the development of urban areas should become smarter. A sustainable and smart city implies proper management and resilience in the face of hazard risks manifestation, and, essentially, means establishing early warning systems (EWSs) and shelters. Smart cities imply using technology and innovation to model contexts, create scenarios, provide alternative solutions, inform and assess impacts (Aelenei *et al*., 2016; Angelidou, 2014). The smart city approach on hazard risk resilience is a perspective on newly developed measures, attitudes and techniques. It focuses on regional risk management, on hazard occurrence, action and reaction, as well as on associated strategies.

1. Resilience - a key concept in hazard mitigation

The term *resilience* was frequently included in the development strategies and policies of the EU, to urge the states to adopt measures favorable to the constantly changing context and, implicitly, to provide the most efficient answers in the event of disturbances of the system. Although not recent, the concept of resilience is still relevant today, especially as the challenges faced by governments and economic agents can be diverse, very few of them having the ability to anticipate them or to find the most appropriate answers to combat them. The reaction speed and the degree of recovery of the systems, following the appearance of some shocks, depend on the extent to which decision makers manage to prepare optimal measures and policies for their absorption, by accumulating the previous experiences. Usually, when discussing about the achievement of a transformation, after the installation of a shock, the capacity of a system to generate new development models, its ability to ensure an upward trend, which exceeds the ante-shock level, needs to be considered. In addition, other characteristics of resilience (resistance, absorption, adaptation) could have different magnitudes in territories, due to zonal peculiarities. There is a possibility that less developed countries to be more resistant to shocks compared to developed ones, but, the latter could prove to be better placed in the direction of recovery. At the same time, it should be noted that this is not a general rule, as the opposite can also happen. With reference to shocks, these can be multiple, and Figure 1 are displays some of them.

Figure 1. Typology of shocks



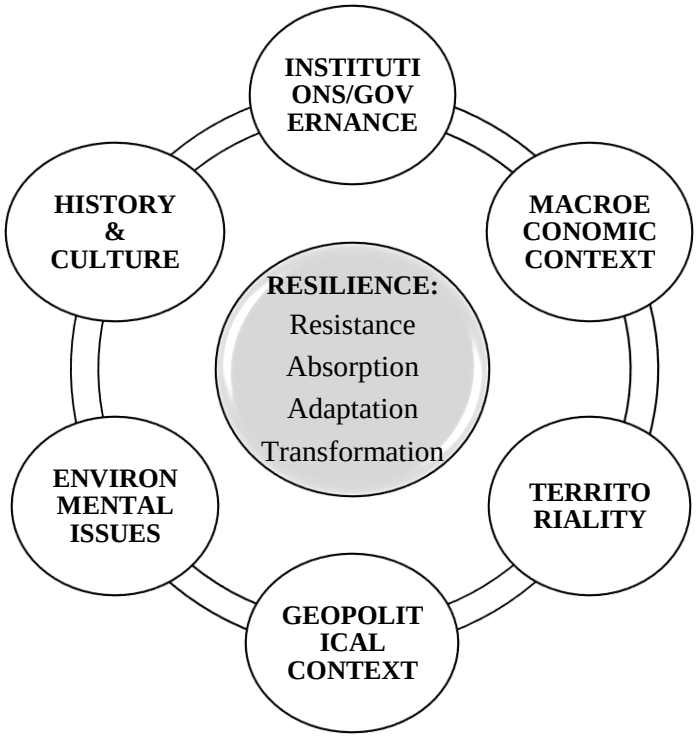
Source: authors' representation based on Sagara (2018)

Resilience can be approached from a multidimensional perspective, but in our paper we will focus on the resilience of institutions and on the resilience of governance system, and this because it is often stated that high institutional quality and a good governance are in strong connection with the capacity to absorb shocks more easily, while institutional weaknesses are associated with lower shock resistance (Fuchs and Thaler, 2018; Cruz *et al*., 2016; Herrfahrdt-Pähle and Pahl-Wostl, 2012; Hills, 2002; Handmer and Dovers, 1996). Thus, on the one hand, the resilience of institutions is defined as being the ability of the system, characterized by a diversity of formal and informal institutions, to cope with change, without collapsing, by adapting to the context (Sjöstedt, 2015; Swidler, 2013).

The resilience of a system to shocks is closely related to its institutional diversity, while "the resilience of an institution is a function of its position and role within the system" (Aligică, 2014, p. 103). According to Steinberg (2009, p. 65) "an institution is resilient if it maintains its effectiveness over time, despite changes and shocks (effectiveness indicates the extent to which the institution fulfills its core mission)". On the other hand, the resilience of governance system represents the capacity of government/public administration to respond effectively to shocks and stressors. In a broad sense, the government/public administration proves its resilience in relation to: the efficiency of the measures taken in conditions of crisis, the quality of the decision-making process and the strategic vision, the capacity to generate transformative policies.

Considering these, in our analysis, institutions emphasize the existing values and rules in a state (laws/regulations/norms), while governance refers to all levels of government, not including other actors than government. The differentiation on the two categories of resilience was necessary in the context in which we intend to capture the relevance of both the rules in society and the governance in preventing certain shocks and minimizing the negative effects of hazards. For instance, a high institutional quality, together with good governance, would ensure the premise of taking timely measures to counteract the damages caused by an earthquake (loss of life, collapse of buildings, pollution, etc.). To be able to effectively fight shocks means, in essence, to have strong institutions, stable governments, and risk experts, who can guarantee a proper hazard risk management. But, as we mention, besides institutions, the resilience has multidimensional valences, reflected in Figure 2.

Figure 2. The determinants of resilience



Source: authors' representation

Therefore, in the analysis of the resilience capacity of a state, several aspects can be considered that may be related to the macroeconomic climate, the historical past, the cultural patterns, geographical/environmental issues, etc. From an institutional point of view, it is important to find the most suitable elements that can prove their adaptability to shocks. Formal institutions (compliance with property rights, contracts, rule of law, etc.) are elements that are taken into account when assessing good governance and that can strengthen the resilience capacity of countries. In addition, national specificity should not be neglected, in the sense that, for example, institutional development in the former communist states was different, depending on their path dependence and also on location (e.g., the influence of the Nordic patterns on the Baltic countries shaped another institutional and individual behavior, strengthening their governance systems in the face of shocks).

2. Methodological approach

From an institutional perspective, the analysis of resilience capacity could integrate indicators such as: control of corruption, government effectiveness, political stability, absence of violence and terrorism, quality of regulations, the rule of law, or, at the same time, issues that capture the values

of a state (morality, trust, responsibility, tolerance, empathy, saving, diligence, perseverance), all these providing an overview of the institutional characteristics likely to contribute to the differences in transformation, adaptation and management of shocks that occur in the economy. However, it should be noted that the governance is usually measured by perception data, thus being difficult to quantify faithfully. Many of the data of an institutional nature are fragmented, the missing values leading to the inclusion in the research only of that variables that have been available for a longer period of time, reflecting the comparability (ante-shock analysis vs. post-shock analysis).

Our research is applied on the EU countries and there were considered certain shocks: a) the integration moment of Central and Eastern European states into the EU: 2004 and 2007; b) the economic crisis of 2007/2008. Viewed in dynamics, the institutional data do not have significant trends, this being justified, because the institutions change in a longer period of time; they are usually much more stable than, for example, socio-economic indicators. In addition, institutions often do not respond immediately to shocks, having a time lag when a change is expected. Shocks must be extremely strong (profound transformations) to lead to variations at the level of institutions.

The methodological approach supposed to complete the following steps: each selected indicator was reported to a shock and to the EU average and two periods were identified: the resistance period (corresponds to the period in which the value of an indicator has decreased to the minimum value after the moment of shock) and the recovery period (corresponds to the period in which the value of an indicator has reached the level before the shock). For these periods, the average variation of each indicator (slope for resistance and slope for recovery) was calculated. After analyzing the outliers, the weights of the variables for the latent factors formed were obtained, using the Principal Component Analysis (PCA). The standardization of the variables (slopes) was computed using the z-scores. In order to measure the resilience of the institutions, we took into account the following indicators: *control of corruption, rule of law, respect of property rights, legal enforcement of contracts, institutional capability, voice and accountability, trust in the political system*. For the resilience of the governance system, we considered: *government effectiveness, trust in Parliament, government integrity, government consumption, business regulations, government enterprises and investments.* The data were collected from secondary sources such as: World Bank - Worldwide Governance Indicators, Bertelsmann Stiftung, Democracy Barometer, World Economic Forum - The Global Competitiveness Index, etc.

3. Results and discussion

Some of the results provided below were achieved by involvement in the research activities of the PNCDI III project *"ReGrowEU - Advancing ground-breaking research in regional growth and development theories, through a resilience approach: towards a convergent, balanced and sustainable European Union"*, implemented by the Centre for European Studies within the "Alexandru Ioan Cuza" University of Iasi.

In the following, we present the equations obtained for the two types of resilience defined (resilience of institutions versus resilience of governance system), related to the two periods considered (resistance period and recovery period).

$$Resilience\ of\ institutions\_resistance = 0.215 * control\ of\ corruption + 0.105 * rule\ of\ law + 0.173 * property\ rights + 0.069 * contracts + 0.108 * institutional\ capability + 0.102 * voice\ \&\ accountability + 0.224 * trust\ in\ political\ system$$

Table 1. Resilience of institutions – resistance (factor loadings weighted by share of variance)

Rotated Component Matrix	Component				Maximum value of factor loadings weighted by share of variance	Principal component analysis (PCA)
	1	2	3	4		
Control of corruption	0.032	-0.121	**0.925**	0.035	3.247	**0.215**
Rule of law	**0.826**	0.144	0.151	0.105	1.585	**0.105**
Respect of property rights	-0.128	**0.858**	-0.155	0.082	2.616	**0.173**
Legal enforcement of contracts	0.186	0.543	0.465	-0.457	1.048	**0.069**
Institutional capability	**0.839**	-0.022	-0.082	0.140	1.636	**0.108**
Voice and accountability	**0.816**	-0.316	0.081	-0.073	1.544	**0.102**
Trust in the political system	0.169	0.055	0.036	**0.930**	3.372	**0.224**
Explained Variance (sum of squared values)	1.448	1.171	1.132	1.117	15.049	1
Expl. Var. / Total for selected factors	0.297*	0.240	0.232	0.229		

Notes: *the estimates were obtained based on the values of the variables with six decimals, but, in order to be easier to follow, we chose to present the results with three decimals. Most of the data on institutions do not vary significantly from year to year and for this reason they appear in statistics with many decimals, thus ensuring a certain degree of comparability between the units analyzed.

According to the analysis carried out, the strongest influence on the resistance of the EU countries is exercised by the following variables: trust in the political system (0.224) and control of corruption (0.215) – Table 1.

$$Resilience\ of\ institutions\_recovery = 0.153 * control\ of\ corruption + 0.125 * rule\ of\ law + 0.388 * property\ rights\ +0.201 * voice\ \&\ accountability + 0.130 * trust\ in\ political\ system$$

Table 2. Resilience of institutions – recovery (factor loadings weighted by share of variance)

Rotated Component Matrix	Component			Maximum value of factor loadings weighted by share of variance	Principal component analysis (PCA)
	1	2	3		
Control of corruption	**0.862**	0.131	-0.018	1.302	**0.153**
Rule of law	0.340	**0.727**	-0.285	1.065	**0.125**
Respect of property rights	-0.132	-0.058	**0.973**	3.288	**0.388**
Voice and accountability	0.022	**0.921**	0.077	1.708	**0.201**
Trust in the political system	**0.794**	0.110	-0.192	1.107	**0.130**
Explained Variance (sum of squared values)	1.507	1.407	1.07	8.471	1
Expl. Var. / Total for selected factors	0.378	0.353	0.268		

The recovery is determined by the degree of assuming responsibility by decision-making institutions and the extent to which citizens have the opportunity to become involved in decision-making process (voice and accountability = 0.201). The respect of property rights (0.388) generates the higest positive effects in the recovery process after the onset of a shock, along with the existence of the lowest possible level of corruption (0.153) – Table 2. Overall, it is observed that the resistance is influenced by informal institutions, while recovery is rather associated with formal institutions.

$$Resilience\ of\ governance\ system\_resistance = 0.121 * government\ effectiveness + 0.208 * trust\ in\ Parliament + 0.086 * government\ integrity + 0.357 * government\ consumption + 0.093 * business\ regulations + 0.131 * government\ enterprises\ and\ investments$$

Table 3. Resilience of governance system – resistance (factor loadings weighted by share of variance)

Rotated Component Matrix	Component				Maximum value of factor loadings weighted by share of variance	Principal component analysis (PCA)
	1	2	3	4		
Government effectiveness	**0.931**	0.092	0.068	0.096	1.775	**0.121**
Trust in Parliament	0.305	-0.026	**0.910**	-0.031	3.036	**0.208**
Government integrity	**0.785**	-0.259	0.358	-0.058	1.262	**0.086**
Government consumption	0.045	-0.041	-0.016	**0.995**	5.213	**0.357**

Business regulations	0.149	**0.790**	-0.489	-0.112	1.367	**0.093**
Government enterprises and investments	-0.170	**0.935**	0.132	0.014	1.914	**0.131**
Explained Variance (sum of squared values)	1.630	1.575	1.218	1.016	14.570	1
Expl. Var. / Total for selected factors	0.299	0.289	0.224	0.186		

In the case of governance system resilience, according to the equations, the general conclusion is that resistance is conditioned by the way in which the governmental consumption is made (0.357), this influencing the trust in Parliament (0.208) – Table 3. Besides these factors, in Table 4, it can be seen that the recovery is also determined by the level of government effectiveness (0.174), more precisely by the government's ability to formulate and implement sound policies and regulations, which to allow long-term development, and by the government integrity (0.148), which refers to issues associated with: trust in politicians, transparency in government policy making, absence of corruption, etc.

$$Resilience\ of\ governance\ system\_recovery = 0.174 * government\ effectiveness + 0.305 * trust\ in\ Parliament + 0.148 * government\ integrity + 0.097 * government\ consumption + 0.086 * business\ regulations + 0.187 * government\ enterprises\ and\ investments$$

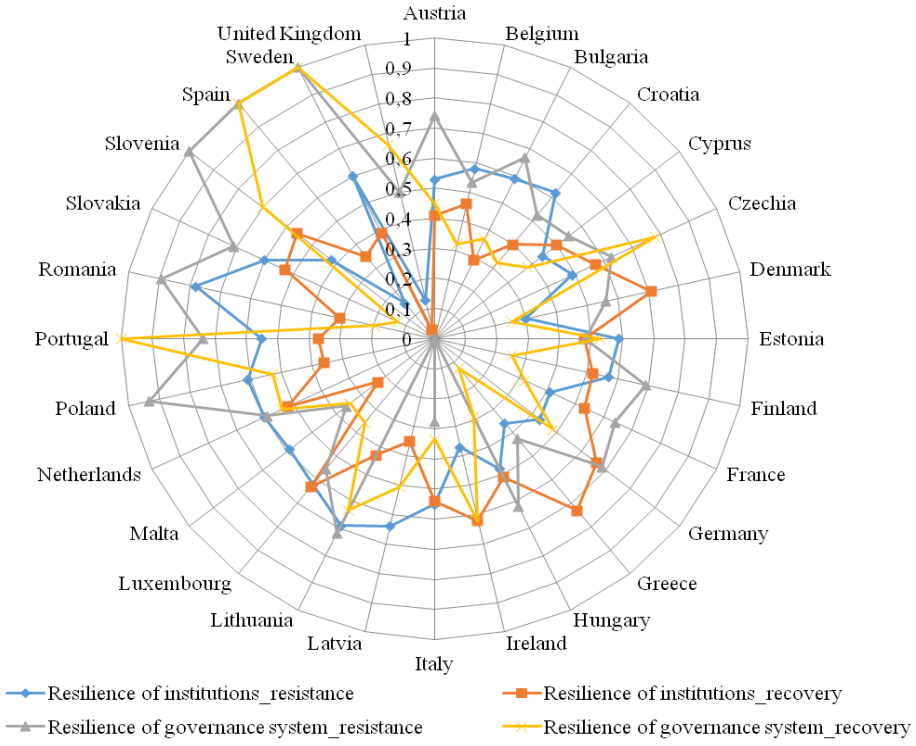
Table 4. Resilience of governance system – recovery (factor loadings weighted by share of variance)

Rotated Component Matrix

	Component				Maximum value of factor loadings weighted by share of variance	Principal component analysis (PCA)
	1	2	3	4		
Government effectiveness	-0.146	**0.922**	-0.001	0.180	2.335	**0.174**
Trust in Parliament	0.145	0.219	0.052	**0.954**	4.095	**0.305**
Government integrity	**0.903**	-0.119	-0.115	0.089	1.995	**0.148**
Government consumption	0.499	0.157	-0.652	0.252	1.303	**0.097**
Business regulations	0.593	**0.648**	0.206	0.195	1.155	**0.086**
Government enterprises and investments	0.046	0.146	**0.907**	0.159	2.516	**0.187**
Explained Variance (sum of squared values)	1.460	1.379	1.306	1.078	13.402	1
Expl. Var. / Total for selected factors	0.279	0.264	0.250	0.206		

We point out that in most European states, there are lower scores in terms of recovery compared to resistance, which indicates that governance systems, although prepared, in many cases, to meet challenges, have failed to produces sufficiently strong shock absorption effects (Figure 3).

Figure 3. Resilience of institutions versus resilience of governance system (resistance and recovery)



Source: authors' representation

Based on the variables used in the analysis, it can be noticed the situation of Sweden, Spain, Slovenia, Poland, which, according to the obtained scores, on a scale between 0 and 1, proved to be the most resistant countries in terms of governance system, in relation to the shocks taken into account. In terms of institutions, Romania and Lithuania are most resistant. Concerning the recovery, Denmark, Greece, Luxembourg (recovery for institutions) and Portugal, Spain, Sweeden (recovery for governance system) are leaders, while Romania (0.190) is at the opposite pole in the direction of governance system recovery, along with Greece and Slovakia, which recorded the lowest scores (both with 0.130). Recovery is usually associated with institutional adaptability to ever-changing contexts. According to the results, the EU enlargement towards East has had a greater impact on the institutional component compared to the economic crisis, and a possible explanation for this could lead to the need to adapt institutions to the requirements of the Internal Market/acquis communautaire, institutions being forced to show greater flexibility and adaptive capacity. If in the case of countries with a long history of EU membership there is an explanation for this position, dictated, in particular, by the ability of institutions to respond promptly and effectively to shocks, in the case of states integrated in the EU after 2004, there is a better ranking of those who directed their resources towards reducing the acts of corruption, by implementing, on a large scale, public sector performance

evaluation and monitoring systems based on the digitization process, so that national and regional actors can increase their mutual trust and to respect the rules of society, especially those related to the enforcement of the contract, property rights, legal systems.

All these results capture the increased importance of institutional quality and governance in combating shocks and their direct link with hazard risk management at the country level. However, it is possible that the management of shocks to be more appropriate in the case of a bottom-up approach, in the sense that smaller territorial-administrative units (such as cities) could act according to local specificities, which, in the end, could mean their ability to be smart and resilient.

4. Smart city approach on hazard risks

The cities, in their complexity, can be considered as a multi-functional puzzle, where each piece has its own vulnerabilities to risks. The capacity for fast recovery and reduced losses associated with hazard manifestation can be correlated to an optimum management of causality, planning and action, leading to the system resilience. The current trend in the development of new technologies, modern tools and innovations ("smart technologies") should be used towards the support of the resilience linked with hazard risks (Parker, 2020; Schroeder and Hatton, 2012; Cutter *et al*., 2008). The main concern has to be focused on preventive measures, prompt response to emergencies, sustainable planning and future growth (Remes and Woetzel, 2019). The integration of these smart technologies in a city management is the fundament of a smart city. In the context of a danger, international organizations (United Nations, 2016) propose recommendations related to:

- ✓ reviewing the resilience policy and development of risk reduction strategies;
- ✓ creation of hazard maps and Geographic Information Systems (GIS) databases to improve risk and vulnerability approaches and establish correlations between threats;
- ✓ improvement of emergency preparedness, early warning and communication;
- ✓ land planning based on seismic mapping;
- ✓ using modern information technologies.

The majority of these recommendations introduce the "smart" concept in risks analysis and management, integrate the concept of innovation, encourage the exploitation of modern technologies in facing hazards and promote the resilience process. Moreover, hazard management cycle covers four stages, namely: prevention, preparedness, response, recovery, as observed in Figure 4 below. Each of these phases has associated smart approaches since a smart city uses innovation and technology for each of them. The smart city approach on hazard risks means being prepared to face,

manage and recover from a hazard manifestation, with minimal losses and the rapid restoration of the disturbed system to its initial equilibrium (although it would be desirable to be even exceeded). Transition from a traditional to a smart management on hazards risks implies being opened to new approaches, incorporating and using the innovation and technology at their full potential.

Figure 4. Hazard management cycle

Source: authors' representation based on El-Kholei (2019)

Hazard risk management described as a four-stage cycle is detailed in Figure 4 with associated actions. Paying more attention and investments in the first two stages will imply a reduced impact for the last two stages. First stage in hazard risk management refers to the creation of a risk profile (define, inform and map), but also increasing the awareness issue among people and administrative bodies. The second stage is about preparedness to face the envisaged hazard risks. It is highly important to perform the assessment of risks in accordance with four main components (hazard, exposure, vulnerability and losses), in order to estimate with high accuracy the probability of the disaster occurring. Based on the identified potential risks, the manner in which the action is to be taken and any interventions associated with the monitoring of the risks should be decided. At this point should also be performed an extended evaluation of consequences linked to a hazard manifestation, available early warning systems (EWS) and potential options. The third stage involves tackling the actual hazard manifestation based on the strategy or plan previously undergone. This stage tests the plan,

questions the preventive and supporting measures, quantifies losses. The last stage in hazard management refers to the recovery period that follows a hazard. It is a stage of reconstruction, improvements and restructuring, this time „smarter" than before.

In terms of the four stages of hazard risk management, a smart city would imply a smart administration of all sectors and resilience, independent of the occurrence and manifestation of the hazard. A smart city addresses some priority areas and according to El-Kholei (2019, p. 141), they are: "build capacity for Disaster Risk Reduction (DRR) activities at local government and community level; recognize the vital role that civil society organizations play in implementing the new framework for DRR; increase funding for DRR; ensure strong accountability; make sure there is coherence between all international development frameworks)". They are also in line with the "Sendai Framework for Disaster Risk Reduction 2015-2030", elaborated in 2015 by the United Nations Office for Disaster Risk Reduction.

The smart city is prepared to face risks, with significant high levels of prevention measures and preparedness strategies, where the third and fourth stages of hazard management cycle register reduced values and impacts. A smart city is a resilient city, safe, developed and sustainable.

Conclusions

Scientific literature promotes the concept of resilience as a new approach in the process of development, meaning the system's ability to resist, absorb, adapt and transform/regenerate. In association with hazard risk management, the resilience is translated as a country/city adaptability and reconfiguration in case of shocks. As the results of the research have pointed out, resistance to shocks or stressors of various kinds and the acceleration of the recovery process can be strengthened through concentrated efforts, through the coordination of economic policies, these being guided by factors such as: accountability, transparency, rule of law. In essence, formal institutions (legal norms, regulations, contracts) intervene in this issue, guiding the activities of an economy, by taking into account some principles that lead to subsidiarity, equity, inclusion, participatory governance. "Good governance is associated with the rule of law and property rights, as well as with the provision of efficient public services through an authority that uses mechanisms, processes and institutions to manage country issues" (Briguglio, 2014, p. 20). From this statement, it follows that in the absence of good governance, chaos is created, public policies are discredited, the levers of action in the economy are weakened and, in the end, the capacity to absorb the adverse effects of a shock will diminish. On such unfavorable ground, with systemic vulnerabilities, the magnitude of the shock will

be much higher, which will lead to low development outcomes. Consequently, according to our analysis, it is highlighted that the institutions establish a causal relationship with resilience, the states that adopt measures to protect them show a greater capacity for recovery after the appearance of a shock. In addition, the institutional adaptability has a great relevance for this purpose: the more the countries adjust their governance systems to the constantly changing contexts, the more they will offer more adequate answers to the possible shocks.

In an international context, characterized by hazard risks, with a wide range of types, frequency distribution and impact categories, the cities should accelerate the level of change. The cities, in their multi-functionality, may face various vulnerabilities. The city, seen as a system, in correlation with the institutional resilience, implies processes of fast recovery and reduced losses. In order to reach such a result, it is necessary to obtain performance in terms of planning and strategy, supported by the new trend in technology and innovation. The smart city approach on hazard risks implies an urban development customized on each city system vulnerabilities and resilience, with focus on perpetual information flow. A smart city is digital and connected to local needs, where the rules are respected, citizens feel protected, the authorities try as much as possible to communicate with them, it has adequate resources to prevent possible risks, etc. In fact, there is a causal relationship between smart governance and smart city.

To counteract the effects of some shocks (landslides, volcanic eruptions, floods, fires, earthquakes, economic crises, etc.), it is possible to act in time by taking anticipatory measures, while in others, the generating sources are not known, the subsequent disturbances being directly proportional to the quality of interventionist policies. Therefore, the institutions have the decisive role in crisis management, the need to adapt them being constant, due to the multitude of unpredictable aspects that may occur. So, broadly speaking, these could be the main directions that can be learned at the city level from the analysis conducted.

Future research may want to capture the differences in terms of crisis management in some European smart cities, considering a multidisciplinary approach, integrating elements specific to the economic, institutional, social, cultural and geographical environment.

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