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Special Issue 1.2021

The Emergency Plan for the use and management of the territory

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THE EMERGENCY PLAN FOR THE USE AND MANAGEMENT OF THE TERRITORY

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The cover image is a photo of the landslide that hit the municipality of Amalfi (Italy) in February 2021.

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Contents

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Fostering holistic natural risk resilience in spatial planning

Earthquake events, cultural heritage and communities

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Abstract
Natural disasters lead to the destruction of (land/urban) scape values and cultural heritage, social and cultural ties, and directly impact spatial resources that appeal to spatial planning with a view to enhancing the current resilience and reducing future risks. The aim of this research is to build a framework of knowledge to integrate perspectives of natural risk resilience (natural risk, cultural heritage, communities, spatial resources, and spatial planning) tested on research cases in areas affected by earthquakes in Italy and Croatia. The Heritage Urbanism approach is applied by comparing the Central Italy disaster and trends in the Croatian capital of Zagreb, providing identity factors and evaluation criteria to assist in reading existing resilience models and building new models. Structures to interrelate aspects of (land/urban) scape resilience and models of natural risk resilience contribute to enhancing risk reduction and resilience in urban planning in high-risk situations. Achieving holistic natural risk resilience is possible when (land/urban) scape, cultural, identifying, social, spatial, planning, and economic resilience models are integrated such that they benefit from each other. Spatial planning responses to natural disasters that affect cultural and (land/urban) scape heritage and spatial resources must be planned in close interaction with local communities to improve preparedness and prevent destruction, damage, and loss of collective memory, tradition, and identity.

Keywords
(Land/Urban) scape values; Comprehensive renewal; Identity affirmation; Central Italy; City of Zagreb.

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1. Introduction

Natural disasters (earthquakes, landslides, floods, droughts, tornadoes, fires, etc.) cause immense losses in terms of human lives, goods, and property. Dealing with disasters is not just a question of destroyed buildings and assets. It involves the destruction or interruption of the ties, connections, and socio-cultural networks in affected communities, the loss or decline of genius loci, and the image of the (land/urban) scape and authenticity, leading to changes in cultural practices and traditions that directly impact the spatial dimension (Sargolini, 2017). It appeals to emergency management, spatial planning strategies, and legislation framework that addresses consequences with a view to reducing future risks and enhancing the current resilience. This research is conducted from the spatial planning perspective, focusing on the contribution of cultural heritage and communities in the course of disaster/risk reduction and natural risk resilience.

The tectonic Apennine-Adriatic-Dinaride region represents a consistent block, with the Apennines and Dinarides being thrust towards a common foreland, though diverging to the south (Ollier & Pain, 2009). The wider spatial context of the research covers active seismotectonic points of the Apennine and Dinaride mountain areas, with the Po and Pannonian plains as bounds towards Alps. The more focused spatial context regards the location of major earthquakes that have occurred in the 21st Century in Central Italy — Apennines — and in Zagreb, the capital of Croatia — Pannonian Basin (Ivančić et al., 2006).

The pace of urban development and the repercussions on the Earth's ecosystem cause global warming, increase risks from natural disasters (earthquakes, extreme weather events, COVID-19 pandemic) and present global problems that demand a paradigm shift in the approach to spatial planning. This paradigm shift is enhanced by the Council of Europe Landscape Convention (Council of Europe, 2000; Council of Europe, 2016), European Green Deal (European Commission, 2019), Agenda for Sustainable Development (United Nations, 2015), and conventions recognizing the value of tangible and intangible cultural heritage for society (Council of Europe, 2005; UNESCO, 1972, 2003, 2019; European Commission, 2018) in forming global long-term goals (Colucci, 2012; Kallaos et al., 2014). The post-disaster processes in Italy (Central Italy) and Croatia (Zagreb) reveal a focus on emergency post-disaster recovery, taking long-term goals as a background. Natural disasters, however, highlight current spatial, social and cultural problems as a reminder to aim for values that enable comprehensive progress. On the national and regional scales, strengthening and encouraging the relationships between spatial, social, and cultural models promotes sustainable development (Council of Europe, 2006) and comprehensive resilience in spatial planning. Inspiration for the research lies in the chance to exchange spatial, community, and cultural knowledge to revive what has been affected by natural disaster.

The research presumes that actions to respond to natural events that affect cultural and (land/urban) scape heritage must be integrated into spatial planning processes and planned in close interaction with local communities to prevent the destruction, damage, and loss of collective memory, tradition, and identity, and to promote social, spatial, and symbolic resilience. Spatial models, as the synthesis of what actually exists and to promote improvements for the future, tie the natural basis of the landscape to the principles of social recognition, especially those related to identity, cultural heritage, ways of life, and social customs or behaviour (Council of Europe, 2006).

The integration of disaster/risk-reduction strategies into the spatial planning process entails a need to simulate the future impacts of disasters, and the most appropriate level to do so is the local level, as stated by the Incheon Declaration (Sargolini, 2020; UNESCO, 2015). However, risk reduction is beyond the capacity of the local authorities because the spatial extent of risks goes far beyond local boundaries, and a multi-level, multi-stakeholder approach would be most effective. Therefore, the goal of the research is to build a framework of knowledge based on holistic links between natural risk preparedness, cultural and (land/urban) scape heritage values in disaster recovery, and comprehensive resilience enhancement concerning spatial planning. This approach is tested on cases of earthquake-affected areas in central Italy and the Croatian capital of Zagreb.

The research question is how and in what ways spatial planning can face risk by increasing resilience, along with the wider implications regarding spatial management.
Central Italy has gained valuable experience in dealing with disaster consequences after the series of major earthquakes in August and October 2016 and January 2017. This experience is compared to trends in disaster recovery in the Croatian capital, which is just beginning to recover from earthquakes in March and December 2020[1]. In the research, the Italian experience of the Central Italy 2016 earthquake and recovery trends from the Zagreb 2020 earthquake are analysed to draw attention to risks and resilience in spatial planning of the cultural and (land/urban) scape heritage and the prosperity of resilient communities with high risk exposure.

1.1 Exchange within the body of natural risk resilience knowledge

According to the UNISDR (United Nations Office for Disaster Risk Reduction), disasters occur when a community has to deal with a situation that exceeds the capacity of public and private entities to cope with it (UNISDR, 2009a). In particular, the UNISDR refers to disasters as "a serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources". Disasters are often described in the literature as a result of: i) the level of exposure to a hazard; ii) specific conditions of vulnerability; and iii) insufficient capacity or measures to reduce or address potential adverse impacts. A disaster therefore affects a territory (Colucci, 2015; Molavi, 2018) in both economic and social terms (Esopi, 2018), with the extent of the damage determined by the type and severity of the disaster, as well as the vulnerability and resilience of the community and related governing bodies. According to the UNISDR, Disaster Risk Reduction (DRR) is a systematic approach to identifying, assessing, and reducing the risks of disasters following natural and non-natural disasters. It aims to reduce socioeconomic vulnerabilities to disasters and address environmental and other dangers that can trigger or can amplify them.
Knowledge regarding natural risk resilience and disaster-risk reduction is based on international conventions, declarations, and documents. Input from international guidelines and directives highlights the need for an inter- and transdisciplinary approach and a comprehensive course in natural risk reduction. An inclusive and holistic approach in achieving natural risk resilience sets the need to overlap/connect different aspects – natural and spatial resources, cultural heritage, community, and spatial planning. Exchanging and enriching different perspectives on natural risk resilience generate the new state of art (Hyogo Framework for Action 2005-2015; Sendai Framework for Disaster Risk Reduction 2015-2030; Making Cities Resilient: My City is getting ready! Campaign 2030).

2. The Heritage Urbanism approach applied

The research approach is based on Heritage Urbanism[2], which sets three methodological levels aiming to recognize/determine/define identity factors, evaluation criteria, and enhancement models (Obad Šćitaroci et al., 2019; Obad Šćitaroci & Bojanić Obad Šćitaroci, 2019). The Heritage Urbanism approach is applied in

[1] Zagreb was hit by earthquakes magnitude 5.5 and 5.0 in March 2020 and again by a series of earthquakes in Petrinja in December 2020 with maximum magnitude 6.4 and epicenter 50 km from Zagreb. In this paper the Zagreb 2020 earthquake refers to the March earthquake, since the December earthquake occurred during paper review and the data regarding earthquake consequences are still unavailable. The Petrinja 2020 earthquakes made substantial destruction to already damaged city of Zagreb. The earthquake effects to both Zagreb and Petrinja area are still being determined and the process of recuperation is currently ongoing, therefore the tendencies of disaster recovery are explored in Zagreb case.

[2] Heritage urbanism is a term created and developed within a research project titled Urban and Spatial Models for the Revival and Enhancement of Cultural Heritage conducted at the Faculty of Architecture of the University of Zagreb. The project lasted five years, from 2014 to 2018, was funded by the Croatian Science Foundation and lead by prof. Mladen Obad Šćitaroci, PhD (Obad Šćitaroci et al., 2019; Obad Šćitaroci & Bojanić Obad Šćitaroci, 2019).

analysing and comparing case studies and assists in reading existing resilience models and shaping new models that integrate natural risk resilience into spatial planning.

The case studies are compared regarding the natural disaster process in two stages with two groups of case studies. Overview examples present the history and consequences of seismic activity in the wider spatial context of the Apennine-Adriatic-Dinaride region including the Po and Pannonian plains. The research cases focus on most relevant earthquakes occurring in the 21st Century in Italy (Central Italy 2016 earthquake) and Croatia (Zagreb 2020 earthquake) presenting the process and challenges of natural disaster events.

The holistic links to natural disaster resilience are achieved when all (land/urban) scape dimensions — spatial, social and cultural (Sopina & Bojanić Obad Šćitaroci, 2019) — are nurtured. The Heritage Urbanism approach is applied on three methodological levels:

- Distinctive factors in the natural disaster process arise from exchange between the (land/urban) scape dimensions and research goal, as natural risk, cultural heritage, communities, spatial resources, and spatial planning;
- Evaluation criteria are used to analyse and compare the case studies and are differentiated for overview examples and research cases. Overview examples are compared through evaluation criteria regarding available data on seismic activity consequences. Evaluation criteria for research cases analysis are confirmed from the overview examples and introduced in two ways: as three phases in the course of a natural disaster and as perspectives of natural risk resilience recognized in extended distinctive factors;
- Existing resilience models are read in (land/urban) scape resilience dimensions and interconnected to foster holistic natural risk resilience. The research proposes resilience enhancement models as a simplified representation of an interrelated structure to advance natural risk resilience.

The materials and information used to conduct the scientific research were limited due to restrictive COVID-19 measures and the shock of the recent earthquake in Zagreb[3]. Therefore, the materials used focus on online publications and cartographic and photographic materials, complemented by data collected in on-site surveys in Central Italy and Zagreb.

3. Case study analysis

3.1 Historical overview of the impact of seismic activity

The history of active tectonic sites in the Apennines-Po and the Dinarides-Panonian regions is presented as an overview of most relevant historical and contemporary seismic events regarding the impact and effects on the territory, communities, and cultural heritage. The overview examples (Tab.1) include five seismic events in Italy (Friuli 1976, Irpinia 1980, L'Aquila 2008, Emilia Romagna 2012, Central Italy 2016) and three of the strongest earthquake events in Croatia at the end of the 19th century (Montenegrin Littoral/Dubrovnik 1979, Zagreb 1880 and 2020) (Šimetin Šegović & Šimetin Šegović, 2020; The City of Zagreb, 2020).

The comparative table and information regard data available on the seismic events and the spatial, community, and heritage consequences. Overview earthquake events range from magnitude 5.0 to 7.0 on the Richter scale, with various epicentre locations causing continental and undersea earthquakes, affecting areas of up to 20,000 square kilometres, up to 1,240,000 inhabitants, and with up to 2,735 casualties. The areas impacted

[3] The research is conducted during the COVID-19 quarantines of high restrictive measures in both Italy and Croatia, and focused on data available in the given circumstances. The research was conducted during the first nine (9) months after the Zagreb Earthquake in March 2020, thus the Croatian team used information available at the time. During the paper review process Zagreb was striken by the Petrinja earthquake in December 2020, that made substantial damage to the city of Zagreb. The effects of Petrinja earthquake to Zagreb are not presented in the paper.

range from low-density areas with small settlements to high-density areas of municipal seats, regional centres, and capital cities, reflecting different degrees of damage to homes, the cultural heritage, and public buildings.

Earthquake	Zagreb	Friuli	Montenegro Littoral/Dubrovnik	Irpinia/Basilicata	Abruzzo	Emilia Romagna	Central Italy	Zagreb
Date	09/11/ 1880	06/05/ 1976	15/04/ 1979	23/11/ 1980	06/04/ 2009	20/05/ 2012 29/05/ 2012	24/08/2016 30/10/2016 18/01/2017	22/03/ 2020
Epicentre	Medvednica mountain	Gemona – Artgena	Montenegro Littoral Bar – Ulcinj	Teora	Roio Colle – Genzano	Finale Emilia – Mirandola	Accumoli – Castelsantangelo sul Nera – Norcia	Medvenica mountain
Magnitude	6.3	6.4	7.0	6.9	6.3	5.9	6.5	5.5; 5.0
Victims/Injured	2 / 29	965	136 / 1,700	2,735	308	27	303	1 / 27
Left without homes	/	45,000	100,000	280,000	65,000	15,000	40,000	1,000
Affected inhabitants	30,000	/	/	/	/	/	600,000	1,240,000
Affected area km²	2,500	5,500	20,000	17,000	3,565	2,700	8,000	2,250
Affected Municipalities	/	137	/	687	57	60	140	51
Territorial type	Capital city	Small mountain centres	Regional centres, UNESCO Sites	Small and medium centres – Naples	Small and medium centres	Small centres, valley farms	Small and medium centres	Capital city
Population and building density	Low density	Low density	Low to high density	Low to high density	Low to medium density	Low density	Low to medium density	
Destroyed or unusable homes	485	18,000	/	20,000	22,816	37.122 in total 37% usable 22% damaged 41% unusable	49,954	5,843
Damaged homes	1,273	75,000	60,000	80,000	11,337		30,392	18,157
Damaged cultural heritage	/	/	1,376 in Dubrovnik Littoral	/	1,366		945 (Churches*)	364 Cultural Religious
Damaged public buildings	/	/	/	/	1,029		1,405	513 Health Education

* other cultural heritage is counted under "homes" and "public buildings"

Tab.1 Overview of historical earthquake consequences in the Central Italy and the Republic of Croatia (selection)

A comparison of the overview examples indicates different disaster severity, effects, and consequences, that are expressed as earthquake impact factors (Jurukovski, 1997; Lomnitz & Winser, 2012; Choudhury et al., 2016; European Commission, 2018) – location and depth of the epicentre, local geological conditions[4], magnitude, population and building density, level of economic development, level of social and cultural development, communication, accessibility for rescue teams, time of day, time of year and climate, secondary effects. Different primary and secondary earthquake effects (Choudhury et al., 2016), as well as the short- and long-term consequences of earthquake impacts (Clemente & Salvati, 2017), confirm earthquake-disasters as a process (Mulargia et al., 2004).

The extended identity factors of the natural disaster process are related to the earthquake impact factors and are therefore confirmed as evaluation criteria for the research cases. The earthquake events in Central Italy (2016) and Zagreb (2020) were selected as the most representative seismic events occurring in the 21st Century in Italy and Croatia for further analysis of the research cases.

[4] The area of impact is influenced by the location and depth of the epicenter and the local geologic conditions. In the case of Montenegro Littoral 1979 Earthquake, the epicenter was located about 15 kilometers from the sea coast between Bar and Ulcinj, having the strongest impact along the coastal area, with a significantly less impact on the continental mountain area. In the cases of continental earthquake events, the area of impact is mostly radial from the epicenter location.

3.2 Research cases — analysis of approaches to natural disaster change and challenge through pre-shock, shock, and aftershock phase

Analysis of the research cases was conducted using evaluation criteria – three phases in the course of a natural disaster and perspectives on natural risk resilience (Table II and III)[5]. The course of an earthquake encompasses the three phases of:

- pre-shock, preceding earthquake as the stillness phase;
- shock of earthquake and action as an emergency phase;
- aftershock of reactions and dealing with effects of the earthquake as a recovery phase, exposing the natural disaster as a process.

Perspectives on natural risk resilience are recognized in extended identity factors of the course of the natural disaster:

- natural risk (natural disaster and area affected);
- cultural heritage (protected cultural heritage and (land/urban) scape heritage);
- communities (collective meanings and local community);
- spatial resources (professional initiatives and spatial management);
- spatial planning (spatial planning strategies and legal framework).

The description of each research case summarizes the processes and challenges of natural disasters and emphasizes each disaster phase regarding spatial planning strategies and natural risk resilience.

3.3 Central Italy 2016 Earthquake

In 2016, the Apennine area of the 4 regions of Central Italy (Lazio, Umbria, Abruzzo, and Marche) was hit by a series of seismic events (Tab.2). The sequence began on 24 August 2016 with a 5.9-magnitude earthquake that caused the death of 297 people and the total destruction of the town of Amatrice, near the epicentre, Accumoli, and Pescara del Tronto. On 26 and 30 October 2016, new violent shocks rocked the same area, affecting the Umbria and Marche regions in particular, which were already deeply affected by the 24 August earthquake. The 26 October event featured two strong events of magnitude 5.4 and 5.9, and on 30 October another strong shock led to new damage and collapsed buildings. Unlike the August event, no victims were reported this time, but tens of thousands of people were involved and the number of damaged and collapsed buildings was even higher (Sargolini et al., 2019).

On 18 January 2017, four earthquakes of magnitude greater than 5 hit the Lazio and Abruzzo regions again. In this case, the event overlapped with an exceptional wave of bad weather and snow that affected the Abruzzo, Lazio, Marche, and Umbria regions and beyond. This multi-hazard caused an avalanche on the Gran Sasso d'Italia massif, hitting and destroying the four-star Hotel Rigopiano in Farindola, Abruzzo, with 29 deaths and 11 people injured, making it the deadliest avalanche in Italy since the White Friday avalanches in 1916 and the deadliest in Europe since the Galtür avalanche in 1999.

The Civil Protection Department coordinated the Central Italy earthquake emergency. Dicomac – Command and Control Directorate, established in Rieti after the Civil Protection ordinance of 26 August, managed the first emergency phase, focusing mainly on assisting the population (contributions for "independent accommodation", emergency housing solutions); recognizing damage to housing (Fast and Aedes reports), the artistic and cultural heritage, and public buildings; collecting and transporting rubble; and supporting livestock activities.

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[5] Tables II and III that research perspectives on natural risk resilience of the Central Italy 2016 Earthquake and Zagreb 2020 Earthquake represent the choice of resilience dimensions that are focused on achieving research goals, and represent the information quantity that enables the implementation of the research.

Perspectives on natural risk resilience of Central Italy 2016	**Pre-shock** Preceding earthquake Stillness phase	**Shock** Earthquake force and action Emergency phase	**Aftershock** Earthquake reactions and effects Recovery phase
Natural disaster	Umbria-Marche 1997: M 6.0 L'Aquila 2009	24 August 2016: M 6.0; 5.3 26 October 2016: M 4.4; 5.9 30 October 2016: M 6.5 18 January 2017: M 5.1; 5.5; 5.4; 5.0	Approximately 65,500 aftershocks recorded from 24 August 2016 to 28 April 2017 (3500 with magnitude equal to or greater than 2.5)
Area affected	Umbria-Marche 1997 L'Aquila 2009	4 regions, 10 provinces 8,000 km^2 Abruzzo 103,483, Lazio 72,798, Marche 348,473, Umbria 57,505 inhabitants	Extraordinary Commissioner and Regional Special Offices for Reconstruction – management and approval of reconstruction projects
Protected cultural heritage	Real estate and property Cultural-historical units Protected and preventively protected (national parks, natural reserves, N2K network)	Most severe damage to historical settlements and buildings	Implementing heritage enhancement projects in relation to the context An effective conservation model is not defined
Urbanscape heritage	Heritage uniformity Protected small settlements, hamlets, and individual buildings	New emergency settlements in contrast to old ones New urban landscape and new territorial organization	Focus on historical urban settlements, both in terms of single interventions and settlement organization
Collective meanings	Strong landscape identity and historical-cultural value of the built environment	Collective meaning identified with ruins of historical heritage Fallen cathedrals, severely damaged towers became earthquake icons	Practices of cultural institutions and artistic/cultural initiatives as a means of dealing with earthquake consequences
Local community	City and local initiatives protect public and green places as public goods and places of community identification	More than 300 victims, more than 65,000 left homeless Emergency phase managed by Civil Protection and National Government – local communities and authorities not engaged Informal network of help	Personal actions and community initiatives in dealing with earthquake consequences, while waiting for institutional assistance and inclusion
Professional initiatives	Professional associations and initiatives educate and raise awareness about the value of public goods and public urban places	Emergency response policies involve volunteers in post-earthquake actions	Intense debate between professional associations, central government, and the Special Commissioner for Reconstruction processes
Spatial planning	"Struttura Urbana Minima" approach to rethinking urban organization in light of seismic risk prevention CLE Civil Protection Plans	Civil Protection coordinates the immediate disaster response and organizes a preliminary inspection of buildings to establish damage	Sustainable and responsible relationships with urban spatial resources
Legal framework	Individual regulations related to Disaster Events Law to manage the emergency after disasters	Department of Civil Protection and network of first responders	General Reconstruction Law Thematic ordinances for the reconstruction and local economic development
Emphasis of each disaster phase regarding spatial planning and natural risk resilience	Meeting possibilities of spatial resources, social needs and desired improvements	Emergency management Emergency response policies involve volunteers	Renewed focus on potential links to seismic security, energy efficiency, urban organization and safety, and local development

Tab.2 Perspectives of natural risk resilience of Central Italy 2016 Earthquake

The state of emergency was declared after 24 August, extended after the strong earthquakes on 26 and 30 October, and extended again after the four shocks on 18 January and the exceptional snowfalls that affected Abruzzo, Lazio, Marche and Umbria. An initial list of 17 municipalities affected by the earthquake emerged from the decree to defer tax obligations due to the severity of the damage suffered, which was issued by the Ministry of Economic and Finance on 1 September 2016. Subsequently, on 9 September 2016, due to the complex situation of the territories, the President of the Republic issued a decree to nominate an Extraordinary Commissioner of the Government for Reconstruction in the Regions of Abruzzo, Lazio, Marche, and Umbria. The Commissioner's task was to: i) coordinate state administrations in conjunction with Regional Presidents and Mayors and the National Anti-Corruption Authority, to define plans, intervention programs, necessary resources, and administrative procedures to reconstruct public and private buildings and infrastructure in the areas affected by the earthquake; ii) ensure, jointly with the Head of the Civil Protection Department of the

Presidency of the Council of Ministers, the necessary connection between the respective areas of coordination; and iii) report to the President of the Council of Ministers on activities and initiatives to achieve the objectives. Thus, while Dicomac proceeded with the emergency management regarding the aspects of immediate support to the population and economic activities, the Extraordinary Commissioner began to define the means to implement the post-earthquake reconstruction phase.

On 17 October 2016, the Decree Law 189/2016 was published, which regulated interventions to repair, reconstruct, assist the population, and recover economic activities in the four regions affected by the earthquake. The Law was based on several essential elements:

- division of interventions into two distinct phases (emergency and reconstruction) and related competences and activities between the Department of Civil Protection (responsible for activities in the emergency phase) and Special Commissioner (responsible for reconstruction activities);
- a highly centralized reconstruction structure with the Extraordinary Commissioner;
- as the pivot of the system and coordinator between the different authorities (at the national, regional, and local levels);
- significant involvement of the Institutions and Authorities to guarantee protection the legality and supervision of expenditures;
- the presence of regional structures (USR – Uffici Speciali per la Ricostruzione) to support the Regions in the reconstruction process;
- spending autonomy through exceptional accounting;
- the right of the Extraordinary Commissioner to make exceptions to ordinary laws, without prejudice to compliance with the general principles of the legal system, to give immediate impetus for reconstruction;
- a legal framework and a department organized around several institutional competent levels to define the strategic elements of the reconstruction.

After the October earthquakes and expansion of the affected area, the Decree Law 189/2016 was converted with amendments in Law 229/2016 of 17 December 2016. The law introduced innovative elements to make the reconstruction approach more appropriate considering the increase in territories and municipalities affected by the seismic events of 26 and 30 October, for a total of 131 municipalities. The list was extended to 138 municipalities after the shocks in January 2017.

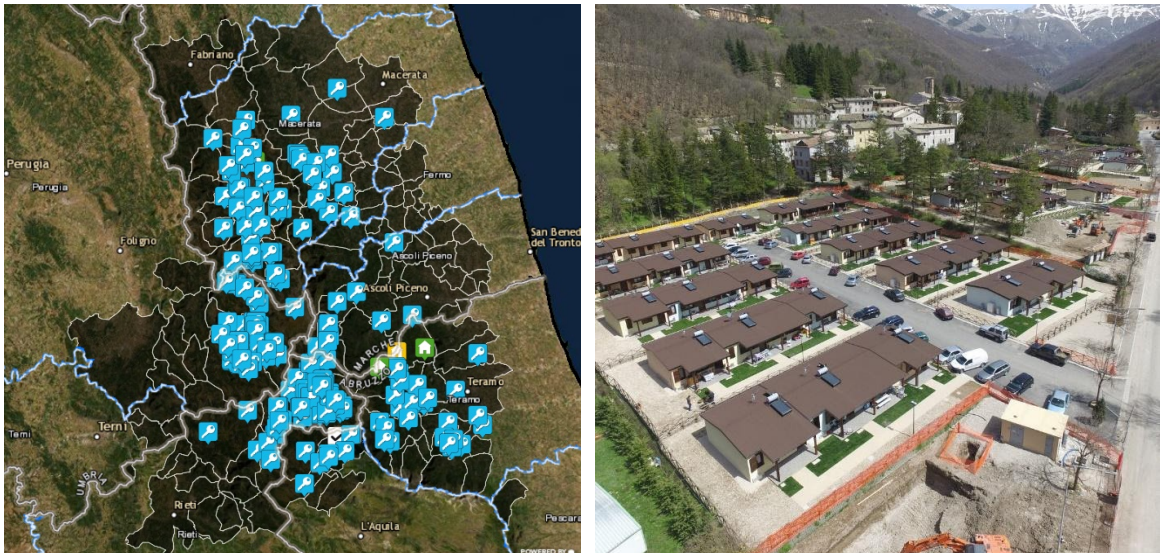
Reconstruction was divided into private and public reconstruction, and the Decree Law defined not only the reconstruction activities, but also the methods to disburse and report contributions. The implementation of the Decree Law provided a robust system for monitoring the reconstruction process, not only in terms of physical reconstruction, but also to support the economic regeneration of the territories.

The commissioner formally launched the standardization activity to implement the principles and objectives in the Reconstruction Law on 10 November 2016, with the publication of Ordinance nos. 1 and 2. To date, there have been four Extraordinary Commissioners, and 110 Ordinances have been published with specific indications for reconstruction.

The emergency phase

In Italy, regional contexts differ widely, and most refer to the Operating manual when preparing Municipal or Inter-Municipal Civil Protection Plans (Italian Presidency of the Council of Ministers, 2007). In January 2019, 87% of Italian municipalities were equipped with municipal civil protection plans, with peaks of 100% in some regions and only one region with a percentage below 50% (Sicily). Among the most critical points, emergency planning is not designed as a process of continuous updating; community engagement in the various phases of the emergency planning process is mostly expected but not practiced; methods of construction in event and risk scenarios do not reference any prefiguration of possible chains between primary and secondary

events, which may constitute one of the main factors in the failure of the response; and municipal or inter-municipal Civil Protection Plans are not integrated into ordinary planning or specific sector planning. With this context, after the 24 August earthquake, the Civil Protection provided 43 reception areas and temporary solutions. The shocks in October represented a turning point in assistance for the population due to the high number of people left homeless and winter's imminent arrival. Most of the affected population was forced to leave their towns, with housing in hotels and accommodation facilities along the coast. Residential container solutions — integrated with modules for offices, services, common rooms, and cafeterias — were adopted for citizens unable to leave their territories.



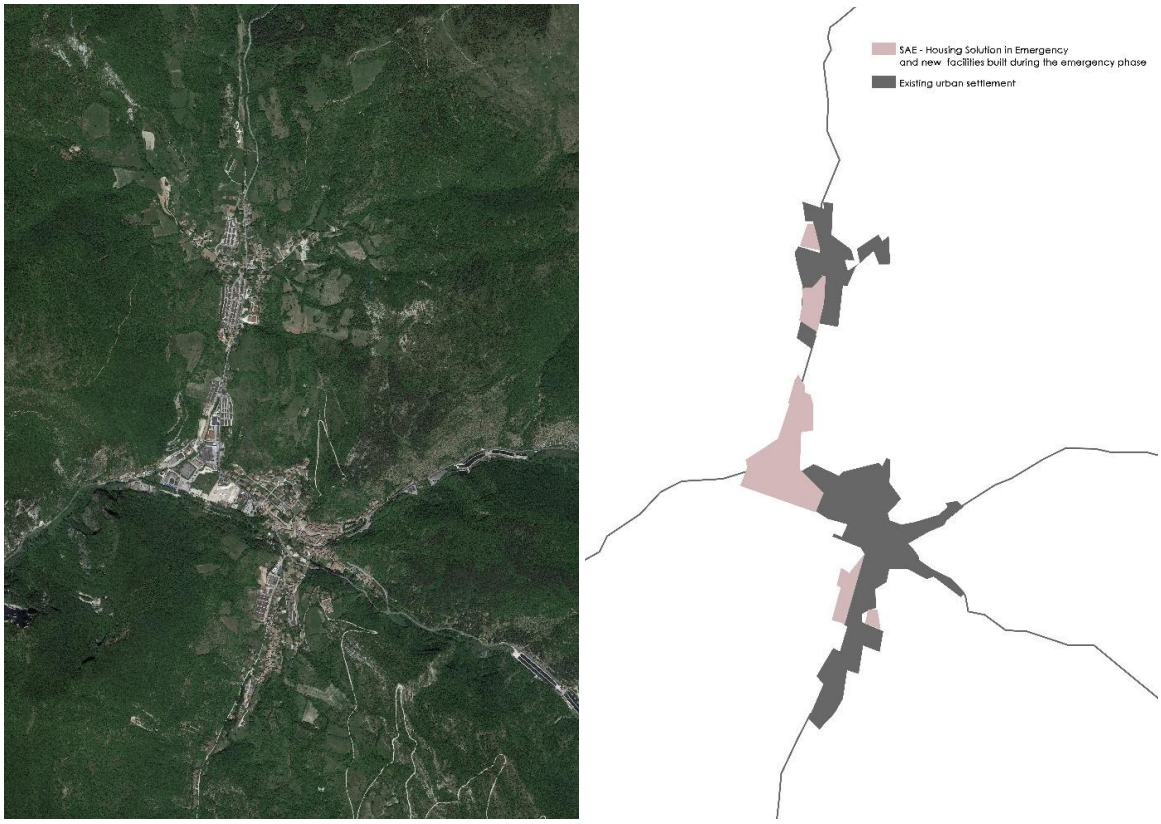
(a) (b)

Fig.1 (a) Map of the distribution of the 228 SAE – Emergency Housing Solutions in the area affected by the earthquake; (b) Examples of SAE – Emergency Housing Solutions in Ussita – Location Pieve Capoluogo

In the meantime, the Department of Civil Protection activated specific contracts to build Emergency Housing Solutions (SAE) for citizens whose homes were uninhabitable or in the "red zone", so they could live in the affected areas until the end of the reconstruction (Fig.1a,1b). SAEs are removable and temporary convertible solutions of 40, 60 and 80 square metres, made with a wooden frame, and respect energy-saving and seismic risk prevention principles. SAEs are built fully furnished and connected by pedestrian paths and green areas, suitable for any climate conditions, and without architectural barriers to guarantee the accessibility of all users. The new settlements were built under exemption from the current planning system and rules in the name of the emergency and the need to house the resident population.

A total of 228 settlements were built to offer safe housing and allow the population to remain in the territory. In fact, besides the issue of dealing with the aftermath of that tragic disaster, the area in question featured (and still does) multiple disadvantages (Pierantoni & Sargolini, 2020; Shirvani Dastgerdi et al., 2019). These include the systemic, chronic crisis of inland areas, which represent a large part of the seismic area (namely, the demographic, social, and economic decline parallel to the growth and success of large urban systems along the coast and valleys) and the financial crisis of 2007, which has not truly been overcome. Construction was concluded in 2018.

While this construction has allowed people to be accommodated safely and comfortably for the entire duration of the reconstruction process, the location of the areas and the new urbanizations have changed the urban landscapes in most cases (Fig.2a, 2b). Entirely new settlements were built alongside existing historical ones, sometimes with significant impacts on the landscape. This raises further questions and challenges about the future of these areas when the historical building heritage is usable again (Stimilli & Sargolini, 2019).



(a) (b)

Fig.2 (a) Orthophoto of the changed (land/urban) scape after the emergency phase in the case of Visso; (b) Diagram of relationships between existing (land/urban) scape and new facilities of SAE – Emergency Housing Solutions (pink) in the case of Visso, built during the emergency phase

What emerges from the Italian experience is that emergency management must be planned in advance and cannot be achieved without implementing profound interaction with the urban and territorial planning system, while remaining a technical engineering activity. Many aspects of planning and programming can foster better resilience of the communities concerned, from improving living conditions and job opportunities to environmental sustainability and quality of health, from training individuals to strengthening economic and social organizations, public institutions, and territories. In this sense, emergency planning should be intended as prevention planning, focusing on the interaction with the populations concerned by adopting the citizen-science paradigm in the relevant phases of the emergency cycle.

The recovery phase

After the series of events, 49,954 private buildings were destroyed or made unusable, and 30,392 were damaged; around 1500 public buildings were damaged, and about 1000 churches were severely damaged.
As of June 2020, 13,948 requests for grants to reconstruct private buildings have been submitted. Of these, 5,325 were accepted, 678 rejected, and 7,945 are currently being processed.
The various ordinances issued by the Commissioners have identified and financed the restoration of 1,405 public buildings (including 250 schools), 942 churches, and also 172 micro-zoning plans for seismic prevention and 94 perimeter enclosures around the most affected centres. Eighty-six public buildings projects were implemented and completed, and another 85 are in progress; 100 churches have been restored, with another 45 construction sites open. The recovery phase particularly focuses on the attempt to coordinate individual interventions and integrate building reconstruction with energy efficiency and sustainability.
Ordinance 25 (23 May 2017) and Ordinance 39 (8 September 2017) are the two regulatory references for spatial planning. The first defines the criteria according to which the Regions see to the perimeter of the centres and settlements of particular cultural interest or parts thereof which were most affected by seismic

events and in which individual interventions (reconstruction, repairs with overall seismic reinforcement and repairs with point-like reinforcement) must be coordinated and implemented through specific local urban plans. The second defines the guiding principles and general criteria to define and implement local urban plans for reconstruction interventions in historical centres and settlements of particular cultural interest. It also introduces the "Documento Direttore per la Ricostruzione (DDR)", which is a strategic non-binding document to address reconstruction by providing a strategic framework to guide actions and individual interventions on the local scale. Since it represents a voluntary, independent act for a single municipality, drafting a DDR allows for the public participation of local communities to define and outline the general reconstruction strategy and is highly recommended for municipalities with more extensive and severe seismic damage where emergency interventions have changed the urban landscape. The DDR is meant to reconsider the organization of the urban system as a whole to raise the level of safety (based on the Minimum Urban Structure approach) and improve the functionality of the services offered to local communities, relating the existing settlement to the new and restored settlements due to emergency interventions (Fig.3). Ordinance 39 introduced the DDR with the aim of integrating and coordinating the implementation of the urban local plans defined under Ordinance 25/2017, orienting public and/or private investments in line with the strategic framework, and updating existing urban planning tools and local plans. At present, only a limited number of municipalities have begun the participatory process to define the Strategic Document for Reconstruction. Some municipalities, such as Arquata del Tronto, have started and already concluded the process; others, such as Caldarola and Castelsantangelo sul Nera, are launching the participation process.

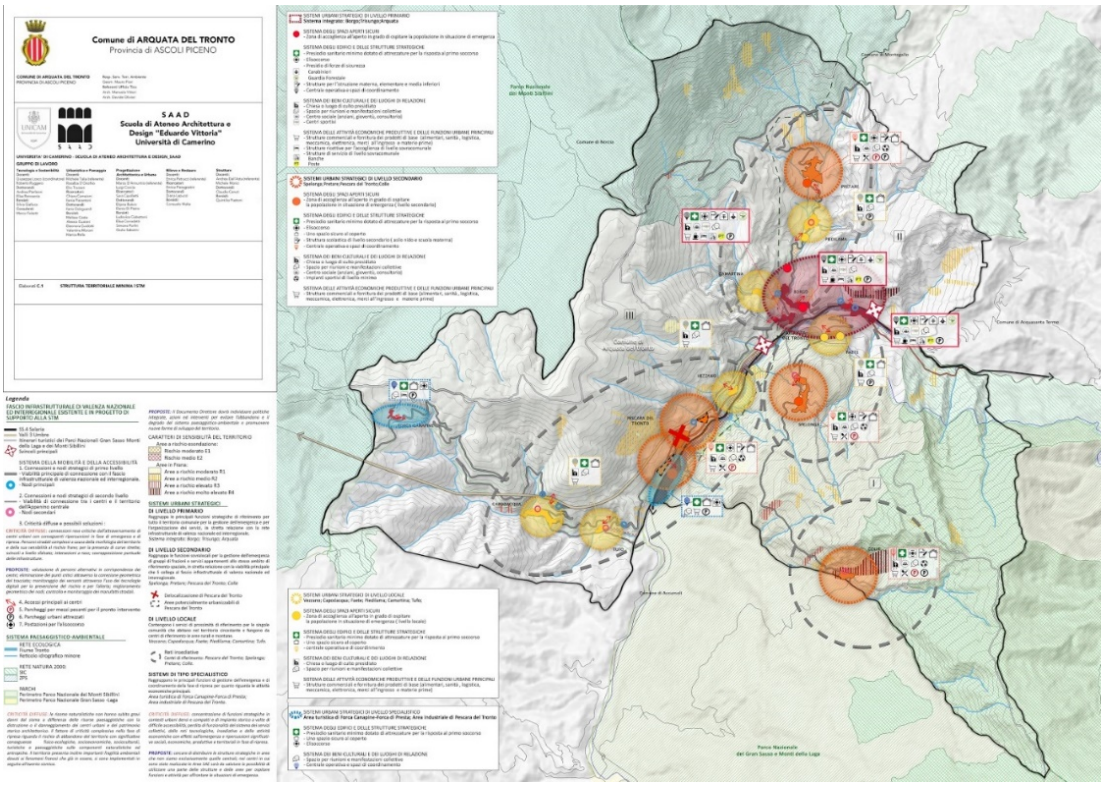


Fig.3 The example of the DDR (Documento Direttore per la Ricostruzione) of Arquata del Tronto: the minimum territorial structure. First example of testing of the Ordinance 39 in the seismic crater

3.4 Zagreb 2020 Earthquake

The Croatian capital of Zagreb was hit by an earthquake on 22 March 2020, with a magnitude of 5.6 on the Richter scale, in the midst of the COVID-19 quarantine. This was followed by a strong 5.0-magnitude aftershock. The restrictive measures implemented on a national level to slow the spread of COVID-19 made the immediate response and comprehensive earthquake recovery (Tab.3) even more demanding (Government

of the Republic of Croatia, 2020). At the same time, the quarantine forced the majority of citizens to stay at home indoors, which contributed to low casualties. Although there was no major collapse of city blocks or complete breakdowns of individual buildings, the total damage was spread over a large, densely built and architecturally sensitive urban area (Ministry of Culture and Media, 2020).

Perspectives on natural risk resilience of the Zagreb 2020 Earthquake	**Pre-shock** Preceding earthquake Stillness phase	**Shock** Earthquake force and action Emergency phase	**Aftershock** Earthquake reactions and effects Recovery phase
Natural disaster	The Great Zagreb 1880 Earthquake M6.3	Zagreb 2020 earthquake and aftershock, M5.5 and M5.0, COVID quarantine	Series of lower magnitude earthquakes, COVID fluctuations
Area affected	Zagreb Urban Agglomeration 1,000,000 inhabitants 2.825 km^2 area	City of Zagreb, Zagreb County and Krapina-Zagorje County declared state of emergency	Act on Reconstruction of earthquake-damaged buildings in the City of Zagreb, Krapina-Zagorje County and Zagreb County
Protected cultural heritage	Immovable and movable cultural goods Cultural-historical units Protected and preventively protected	Most severe damage on Historical Urban Ensemble Damage to sacred/public buildings, museums, galleries and sacred inventories	Bad overall state of cultural heritage funds is evident Old questions about archives, implementing enhancement, defining conservation model
(Land/Urban)Scape heritage	Heterogenous heritage, urban picture and value of the whole of Upper and Lower Town can be applied to all of Zagreb	Zagreb urban picture is damaged by fallen chimneys, gable walls, damaged roofs, collapsed towers and domes, endangered by not restoring existing heritage	Focus on Historical Urban Ensemble of Zagreb, overlooking the wider historic and cultural context
Collective meanings	As the Croatian capital, Zagreb houses the majority of state functions, cultural institutions, and contents	Collective shock identified in material ruins of empty town Fallen cathedral towers and severely damaged buildings become earthquake icons	Urban identity shaken Practices of cultural intuitions and artistic interventions – dealing with earthquake consequences
Local community	City and local initiatives protect public and green places as public good and places for community identification	One dead, dozens wounded, thousands left homeless and hundreds of thousands living in damaged homes Informal assistance network	Personal actions and community initiatives in dealing with effects, while waiting for institutional assistance
Professional initiatives	Professional associations and initiatives educate and raise awareness about public good and the value of places	Emergency response policies involve volunteers in post-earthquake actions	Professional publications Amendment of professional association on Renewal Act Professional conferences
Spatial management	Croatian National Platform for Disaster Risk Reduction National Disaster Risk Management Strategy finalized in 2020	Civil Protection coordinates the immediate disaster response and organizes preliminary inspection of buildings to establish damage	Sustainable and responsible relationships with urban spatial resources
Spatial planning strategies	Spatial planning hierarchy in Croatia differentiates strategic from implementation plans of state, County, City/Municipality, and local level	Ministries coordinate short and long-term support, preparation of application for EU Solidarity Funds (EUSF)	Program for comprehensive renewal of the Historic Urban Ensemble of Zagreb Pilot Project of Block 19 to test renewal models
Legal framework	Regulatory framework in two fields covered by Building Act and Physical Planning Act	Current regulations used to guide and establish obligations for immediate reconstructions	Reconstruction Act primary goal – achieving mechanical resistance, secondary is overall urban renewal Fund for Reconstruction Expert Council for Reconstruction
Emphasis of each disaster phase regarding spatial planning and natural risk resilience	Meeting possibilities of spatial resources, social needs and desired improvements	Emergency management Emergency response policies involve volunteers	Post-disaster and urban renewal policies focused on the most severely damaged protected cultural/historical core

Tab.3 Perspectives of natural risk resilience of Zagreb 2020 Earthquake

Zagreb is found at the tectonic junction of the Alpine-Panonian and Dinaridic blocks (Ivančić et al., 2006). Mount Medvednica and the surroundings of Zagreb belong to a wider seismotectonic area in the border zone between the western and central part of the Pannonian Basin lying towards the Alpine and Dinarides blocks

(Kuk et al., 2000). Zagreb has a history of periodic earthquakes, with The Great Earthquake occurring in 1880. This brought devastating consequences to the city but is considered a major catalyst for the rapid development of Zagreb at the end of the 19th century. The Lower Town, a historical town of urban blocks, was formed at the turn of the 20th century. The Lower Town and medieval Upper Town are protected as the Historical Urban Ensemble of Zagreb, which suffered the most damage in the 2020 earthquake (MCM, 2020) and are therefore in need of renewal.

The area most affected by the 2020 earthquake[6] is the Zagreb Urban Region[7], which corresponds to a functional area structuring the territory, social phenomena, economic factors, heritage and (land/urban) scape values, and territorial coherence (CEMAT, 2017). The Zagreb Urban Region includes the City of Zagreb, Zagreb County, and Krapina-Zagorje County, with a quarter of the Croatian population. Even though the Reconstruction Act[8] covers all three administrative areas, the renewal policies are focused on the protected cultural-historical core[9], revealing the need for integral urban region renewal in the long-term process of post-disaster renewal.

The earthquake greatly damaged the protected cultural heritage, not just the Zagreb cultural-historical complex, but individual cultural properties located in the wider city area and neighbouring counties (MCM, 2020; Damjanović, 2020). The systematic analysis and inventory of damage through an inter- and transdisciplinary approach, and the individual conservation of each protected element of the heritage regarding recognized values, contextual integrity, and authenticity are needed to implement conservation renewal. The responsibility to protect monuments for disaster preparedness and prevention (Aničić, 2000) also protects both human lives and the heritage by presenting the city heritage as more than just a built structure.

The value, authenticity and integrity of the Zagreb urbanscape heritage derives from the heterogenous whole that goes beyond the cultural-historical core and integrates a range of urban characteristics, structures, and environments into a complex urban picture showing versatile layers of urban development. The greatest damage from the earthquake occurred to residential buildings[10] with fallen chimneys, collapsed gable walls and cornices, and damaged roofs, revealing neglect in the urban core and changing the urban picture. The threat of losing urban diversity, authenticity, and genius loci should be considered in urban and architectural renewal. The urban and natural landscape must be regarded as non-renewable heritage resources, promoting contemporary interventions that are integrated within a wider urban system, respecting the local context and upgrading existing values for the city. Initial personal and collective shock was identified with the material ruins of the earthquake-stricken city but also with the fear of an emptied urban centre and the local community's abandonment of Lower Town. The most severely damaged buildings and city symbols became the icons[11] of the Zagreb 2020 earthquake (Fig.4a, 4b) generating commemorative value. The shaken urban

6 The preliminary assessment of damage to buildings, organised by the Civil Protection Headquarters, reported 26,334 inspected buildings, from which 19,746 are usable, 5,177 are temporarily usable and 1,411 are unusable.

7 The Zagreb Urban Area is one of six case study areas of the international scientific project SMART-U-GREEN – Governing conflicting perspectives on transformations in the urban rural continuum, funded from the EU Horizon 2020, grant agreement No 693443, duration from 2017 to 2021, coordinated by Matthijs Hisschemoller from DRIFT. The research involves cases of Drechtsteden, Regione Marche, Grand Reims, Zagreb, Pskov and Mahilioŭ.

8 The Act on Reconstruction of earthquake damaged buildings in the City of Zagreb, Krapina-Zagorje County and Zagreb County was passed on 11th September 2020.

9 The Reconstruction Act prescribed the preparation of the Program for the Complete Renewal of the Historical Entity of the City of Zagreb, and the Institute for Physical Planning of the City of Zagreb is in charge of it.

10 The housing sector is most affected by total losses (57%), followed by business (29%), health (10%), culture and cultural heritage (3%) and education (1%). Overall 78% of the damage and losses are in the private sector, and 22% in the public sector (Government of Croatia, 2020).

11 The Zagreb cathedral was particularly badly damaged. The cross-adorned top of the southern tower fell from the cathedral, while the north top was severely weakened and removed on April 17th. Another icon of the 2020 earthquake is the housing building in Đorđićeva street from which the gable wall toppled on the street.

identity has been reinforced by cultural practices, artistic interventions, and social recognition that present various means of dealing with the consequences of the earthquake[12].

The development of informal practices in Zagreb was on the rise[13] before the earthquake, mirroring decreasing trust in institutions and a formal framework regarding private interests to the detriment of the public good. In overcoming the consequences of the earthquake, personal actions and local community initiatives formed an informal network while waiting for institutional assistance and financing. A strong cultural identity, vivid society, and community inclusion is vital for the process of post-disaster renewal. The renewal of public space, as the space of life and a place for collective identification, can contribute to creating new values for the community. New renewal policies emerged by involving professionals and volunteers in post-earthquake emergency actions[14]. Professional initiatives continued to raise awareness about public goods and the value of public places[15], promoted publications on construction and urban renewal (Crnogorac et al., 2020; Jukić et al., 2020), discussed amendments to the Renewal Act, and organized professional conferences to educate the public and offer concrete measures to deal with the long-term consequences of the earthquake.

Spatial management regarding disaster risk reduction began in 2009 with the establishment of the Croatian National Platform for Disaster Risk Reduction and adoption of the national Disaster Risk Assessment in 2019. Despite earthquakes being recognized as a major danger, risk-reduction management is spread across multiple sectors (Government of the Republic of Croatia, 2020). Spatial management in post-disaster circumstances needs to address disaster risk reduction as well as sustainable and responsible relationships with urban spatial resources. The spatial planning hierarchy in Croatia defines the strategies and implementation plans for developing a safe, inclusive, resilient, and sustainable country (City Office for Strategic Planning and Development of the City, 2017). In the post-disaster situation, the City of Zagreb introduced the Program for Comprehensive Renewal of the Historical Urban Ensemble of Zagreb, prescribed by the Reconstruction Act, and the Pilot Project of Downtown Block 19 to test models. The proposed models for renewal that will be tested on Block 19 include aspects of conservation, construction, architecture, urban planning, energy, ecology, economics, law, and infrastructure.

(a) (b)

Fig.4 (a) Spatial consequences on 22 March 2020, the day of Zagreb 2020 Earthquake; (b)Spatial consequences on 22 April 2020, a month after Zagreb 2020 Earthquake

12 Cultural practices are hosted through live and online exhibitions dedicated to earthquake (institution units of the Croatian Academy of Arts and Crafts, Modern Gallery), virtual museums (Archaeological Museum), interventions and installations in devastated museum spaces (Art Pavilion in Zagreb), public exhibitions (European Square)...

13 Informal practices of city level are focused on social and environmental justice ('The City is Our','Right to the City','Green Action') and on a local level focused on safeguarding individual public places from private interests ('Keep Our Park – Savica', 'For What? For Kajzerica!', 'Parktication', 'The Blue Horseshoe').

14 Engineers, firemen and professional climbers assisted in removal of the structurally damaged chimney. Preliminary inspections of buildings were performed by civil engineers and architects – volunteers.

15 Professional initiatives 'Zagreb for Me', 'City Acupuncture', '1PercentForCity'.

One of most important steps in the recovery process is the adopted Reconstruction Act, which regulates reconstruction methods and procedures and the means of recovering or removing buildings damaged or destroyed by the 2020 earthquake (Ministry of Culture and Media, 2020). The primary goal of the Reconstruction Act is to achieve the mechanical resistance of damaged buildings to ensure the protection of lives and health. The secondary goal is the urban renewal of Zagreb. The funding expected to rebuild family houses and residential and commercial buildings is just a part of the comprehensive renewal that is needed.
The 2020 earthquake and the pandemic highlighted existing planning, spatial, social, economic, and cultural problems in Zagreb, the poor state of the overall cultural heritage and housing sector in historical urban areas, and the need for regional cohesion and community inclusion in spatial management decisions. The emphasis on sustainable development in the pre-shock phase, emergency management in the shock phase, and post-disaster/urban renewal of the most severely damaged protected cultural-historical core in the aftershock phase of the Zagreb 2020 earthquake reveal a tendency towards post-disaster mitigation rather than natural disaster resilience. Dealing with the consequences of the earthquake and the course of the pandemic should suggest that there are no means of restoring the former state and 'building back better', but that an opportunity is presented to 'build forward better'.

3.5 Comparative analysis of researched cases regarding goals of different approaches to disaster resilience enhancement

By learning from past lessons and tendencies towards future perspectives, this comparative analysis focuses on the challenges of post-disaster change in Central Italy and Zagreb. In the cases compared and researched, the perspectives of natural risk resilience are recognized as different approaches to natural disaster change and challenge (Tab.4). The comparison relates to setting goals for different approaches to enhance disaster resilience. The different approaches and related goals are organized not to presume the hierarchy, order, or importance of components of the resilience enhancement process, but the relationships that lead to increasing comprehensive natural risk resilience.
The comparison of the natural disaster processes in Central Italy and Zagreb reflects common changes and challenges, lessons and examples of best practices that can be learned from Italian experience, and stimuli that arise from tendencies in Zagreb's ongoing disaster recovery. The approach to earthquakes in both Italy and Croatia is aimed at monitoring seismic activity that feeds into the Earthquake Notification System[16] and implementing the Disaster Risk Management Strategy[17]. The objective of post-earthquake renewal focuses on achieving the minimal urban structure in Italy and earthquake-resistant construction in Croatia.
The (land/urban) scape heritage approach appeals to preserving landscape and urbanscape values by affirming the identity of the (land/urban) scape and supporting cultural continuity. For Italy, the tendencies of post-earthquake emergency solutions to shape divergence towards the historical landscape and its inherited values were not acknowledged on time, thus leading to the need for (land/urban) scape renewal. The lesson should not be repeated in Zagreb, which challenges urban and architectural renewal by affirming urban identities. Cultural heritage must be protected as the expression of past legacy, an asset of sustainable development, and a reflection of what is left to future generations. The challenge of Central Italy in contrasting perspectives on conservation requirements and the need for innovation and seismic renewal has not been fully experienced

[16] The Earthquake Notification System (ENS) is one of the most important systems in earthquake consequences mitigation, enabling prompt reaction and assisting civil protection in rescue operations. Italy already has developed ENS (USGS, USAID), while the Republic of Croatia is still in the early stages of developing ENS (Republic of Croatia, 2019).

[17] The Croatian National Disaster Risk Management Strategy is in preparation and should be completed by the end of 2020 (Government of Republic of Croatia, 2020).

in post-earthquake Zagreb, which aims to successfully apply an inter- and transdisciplinary approach to conservation.

Approaches to disaster change and challenge	Central Italy 2016 earthquake	Zagreb 2020 earthquake	Goals of different approaches to disaster-resilience enhancement
Seismic approach	Seismic renewal "Minimum urban structure"	Seismic renewal Fire hazard renewal Construction renewal	Monitoring seismic activity Seismic resistance
(Land/Urban)scape heritage approach	Mitigate divergent post-earthquake emergency solutions and traditional structures (Land/urban)scape renewal	Urban renewal Architectural renewal Urban identities affirmation	Preserving (land/urban)scape values Affirmation of (land/urban)scape identity Cultural continuity Progress tendencies
Cultural heritage approach	Contrasting perspectives of conservation renewal and innovation and post-earthquake renewal	Conservation renewal Need for inter- and transdisciplinary approach	Legacy protection Development asset Reflection of inheritance
Symbolic approach	Cultural and musical events Walks and itineraries across the seismic crater Artistic expositions Landscape identities affirmation	Artistic interventions Cultural practices Urban identities affirmation	Give meaning Intellectual awareness Knowledge transfer Cultural education Affirmation of identity
Local community approach	Exclusion of local community in emergency management decisions Reconstruction Law requires involvement of communities in the decision-making process	'Pro-forma' participation Awareness of collective and personal identity Citizen actions Informal network of help	Developing personal and collective responsibility Raising awareness Prosperous and resilient communities Public participation and community inclusion
Professional approach	Economic incentives for cooperation between individual interventions Need for inter- and transdisciplinary approach	Need for inter- and transdisciplinary approach to urban renewal	Provide instruction Direct progress tendency Public education Raising awareness
Spatial management approach	Emergency management with new living solutions (SAE) Landscape and urban renewal and reconstruction Energy efficiency	Urban and structural renewal Communication renewal Ecological renewal Infrastructure renewal	Fostering spatial resources Public good and interest Authentic, context-integrated interventions Concrete procedures
Regional approach	Functional urban and rural renewal	Functional urban renewal Integration of historic values, current resources, and needs	Fostering regional resources Living space, social recognition Territorial heritage
Spatial planning approach	Strategic Reconstruction Document Local executive plans for reconstruction	Comprehensive renewal Pilot project for testing models Comprehensive digital interoperable platform	Concrete strategies Safe, inclusive, resilient, and sustainable spaces Comprehensive renewal
Legislation approach	General Reconstruction Law Thematic ordinances for reconstruction and local economic development	Reconstruction Act Legal renewal Economic renewal	Concrete protocols Legal regulation

Tab.4 Approaches to of natural disaster change and challenge of the Central Italy 2016 and Zagreb 2020 Earthquake

Symbols and representations signify intellectual awareness, knowledge transfer, and cultural education in the course of restoring identities and giving meaning to resilience enhancement. The affirmation of identity is present in both case studies through cultural and musical events, walks and itineraries to promote the

landscape heritage of Central Italy, and artistic interventions and cultural practices to endorse the urban identity of Zagreb. The problem of 'pro-forma' public participation and exclusion of the local community is evident in Central Italy in post-earthquake emergency management and in Croatia in spatial management and planning. Therefore, local communities must be encouraged to prosper into a robust community, contributing to developing personal and collective responsibility, raising awareness about spatial, cultural, and symbolic values, and empowering them through public participation and community inclusion.

The use of professional knowledge in both Italy and Croatia demands cooperation between different interventions, inter- and transdisciplinary approaches that advance public education and awareness by providing instruction and directing progress tendencies in disaster-resilience enhancement. Spatial management sustains spatial resources, public goods, and interest through concrete procedures that claim authenticity and integration (ICOMOS, 2013). Both cases — Central Italy and Zagreb — indicate the need for authentic, context-integrated interventions that will not create new needs for urban, structural, and energy renewal. A regional approach is needed in both post-earthquake cases to foster resources of living space, social cohesion, and territorial heritage by interrelating historical urban cores, urban, suburban, and rural structures with the natural landscape.

Spatial planning strategies promote inclusive, safe, resilient, and sustainable spaces that benefit from historical values, current resources, and actual needs. In Italy, concrete spatial planning strategies to achieve comprehensive renewal regard the Strategic Reconstruction Document and local executive plans for reconstruction, while in Croatia they regard the Reconstruction Act for earthquake-stricken counties, the local programme for comprehensive renewal of the protected cultural/historical core, and the pilot project of one Lower Town block to test versatile renewal models. Legal framework in both countries – Italy and Croatia support the spatial management procedures, spatial planning strategies, and concrete protocols through acts and regulations that uphold legislation regarding disaster resilience enhancement. The thematic ordinances developed for reconstruction and the local economic development of Central Italy serve as lessons for legal regulation in Croatia.

A comparison of the changes and challenges in Central Italy and Zagreb shows differences that reflect local problems in dealing with earthquake consequences, common threats that must be overcome, but also shared goals. In formal policies regarding the legal framework, spatial planning, territorial cohesion, spatial management, professional engagement, and seismic monitoring activities, post-earthquake renewal is identified as a common goal. Informal practices in the community regarding collective symbols, cultural and (land/urban)scape heritage, expand the intent to identity affirmation. The problems of post-earthquake Central Italy and Zagreb lie in differing formal renewal policies, plans, and strategies to affirm the spatial, communal, and cultural identity. They arise from informal practices and actions taken by the community when trust in institutions declines and they focus on post-disaster mitigation that challenges natural disaster resilience. Shared difficulties that arise from post-earthquake renewal and the affirmation of identity in Central Italy and Zagreb indicate that not all aspects of disaster resilience are considered. For example, the renewal and integration of the historical urban core, urbanized area, and functional region as a whole should be improved, the inclusion of community and citizen groups should be encouraged, and intangible values such as the landscape picture, image of the city, genius loci, and authenticity that arise from affirmation of (land/urban) scape and unprotected cultural heritage should be sustained.

When correlated with developing-high quality (land/scape) scape, raising social integration standards, enhancing culture, and affirming identity, emergency management and (land/urban) scape renewal in the course of natural disasters can address long-term goals of spatial management, spatial planning strategies and legal regulations that deal with consequences with a view to reducing future risks and enhancing the current resilience. The various ties, links, and connections between different approaches to post-disaster

change and challenges interrelate all dimensions of disaster resilience, thus fostering holistic natural risk resilience.

4. Conclusion

4.1 Contributing to holistic natural risk resilience by interrelating (land/urban) scape resilience models

The contribution of this research is twofold: to interrelate (land/urban) scape resilience dimensions and produce models to foster holistic natural risk resilience. The research on fostering natural risk resilience is situated in the wider body of knowledge by reintroducing (land/urban) scape dimensions. As primary (land/urban) scape dimensions, space, society, and culture are tied to perspectives of natural risk resilience, and to consequences and threats of natural disasters that arise from the comparison of the Central Italy 2016 and Zagreb 2020 earthquakes. By grouping perspectives of natural risk resilience and connecting to extended (land/urban) scape dimensions, the dimensions of (land/urban)scape resilience are introduced. Besides the spatial, social, and cultural dimensions, nature, planning, and time are also included (Tab.5). The temporal dimension of (land/urban) scape resilience arises from the perspective of natural risk resilience as a process.

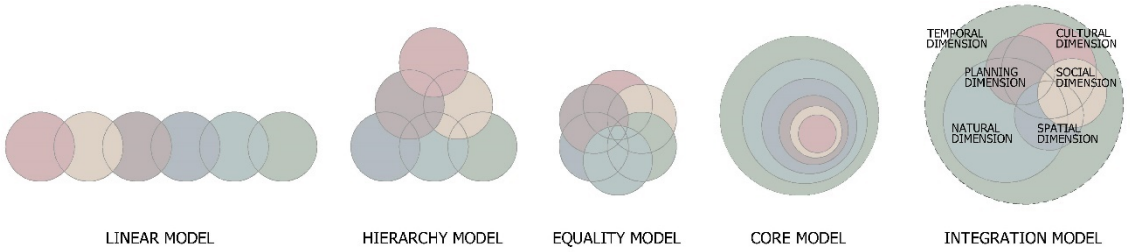


Fig.5 Interrelation structures of (land/urban) scape resilience dimensions as integration models

Different connections between the (land/urban) scape resilience dimensions are presented as diagrams of interrelation structures (Fig.5), which show that order, hierarchy, or importance do not promote holistic natural risk resilience. Interrelation structures are used to present complex relationships between the components of comprehensive notions such as landscape (Swanwick, 2002), sustainability (United Nations, 2015), resilience (ICOR, 2021; Dinshaw & McGinn, 2019; Kwok et al., 2016), and different forms of disciplinarity (McPhee et al., 2018). Linear models present sequential connections of components that form singular or multiple (Shirvani Dastgerdi et al., 2020a; Chambers et al., 2019) branches of implications. Interrelation structures reveal various models of interconnecting the resilience dimensions: hierarchical models (Shirvani Dastgerdi et al., 2020b) and combinations to linear models (European Commission, 2018), equality models recognized as multilayered models (Dinshaw & McGinn, 2019), and combinations of core and equality models (ICOR, 2021, McPhee et al., 2018, United Nations, 2015, Swanwick, 2002). Fostering holistic natural risk resilience is achieved by comprehensively interrelating the resilience dimensions in the integration model (Fig.5). It is presented as an open platform that can also support other resilience dimensions and other means of interrelation. Achieving holistic natural risk resilience is possible when comprehensive perspectives are integrated and interrelated such that they benefit from each other.

The diversity of resilience dimensions analysed in the cases of earthquake-affected areas in Central Italy and the Croatian capital of Zagreb induces various models of natural risk resilience (Tab.5). Different resilience models are introduced as a means of dealing with consequences and threats regarded by different perspectives of natural risk resilience. Specific models such as ecological resilience (Chambers et al., 2019; Wu & Wu, 2013; Folke, 2006), socio-ecological resilience (Folke, 2006), engineering resilience (Folke, 2006), spatial resilience (Chambers et al., 2019), climate resilience (Dinshaw & McGinn, 2019), and social resilience (Kwok et al., 2016)

are distinguished from comprehensive models as general resilience (Chambers et al., 2019) or organizational resilience (ICOR, 2021).

(Land/ Urban) Scape resilience dimensions	Perspectives of natural risk resilience	Consequences and threats of natural disasters	Fostering holistic natural risk resilience		
Natural dimension	Natural disaster	Damage to buildings and sectors of health, education, culture, heritage, business, housing Neglecting interrelations between urban core(s), urban and suburban structures and the natural setting	Identity resilience model	(Land/urban) scape resilience model	Cultural resilience model
Cultural dimension	(Land/urban) scape heritage	Loss of genius loci and (land/urban)scape authenticity Loss of cultural and (land/urban)scape diversity Change in picture and image of the scape Abandonment of liveable heritage cities/towns			
	Protected cultural heritage	Destruction of historic urban cores, settlements, ensemble, and heritage assets General approach to all cultural heritage Long-term process of heritage renewal Contrasting perspectives between conservation requirements and innovation and seismic renewal		Social resilience model	
Social dimension	Collective meanings	Losing sense of community – collective memory, symbols, and identity Losing sense of belonging Changes in cultural practices and traditions			
	Local community	Uprooting of communities, home abandonment and emptied towns and settlements Breakdown of social ties Job losses and difficult transfer of business 'Pro forma' participation – community excluded from the process of post-disaster renewal			Economic resilience model
Spatial dimension	Professional initiatives	Ignoring professional instructions Neglecting general public education Lack of cooperation between/among professions, investors	Spatial resilience model		
	Spatial management	Emergency management for living solutions endangers long-term objectives Favouring private interests to the detriment of the public Interventions without context integration, authenticity and interrelations forming network Gentrification, touristification, apartmenization, festivization		Planning resilience model	
	Regional approach	Focusing on worst affected/protected areas Neglecting natural disaster resistance of the whole region			
Planning dimension	Spatial planning strategies	Enhancement of spatial planning problems preceding the earthquake Emergency requests pressure on spatial planning Consumption of land and spatial resources with emergency solutions			
	Legal framework	Pressure on legal framework for emergency acts Continual amendments of renewal acts Community turning to informal practices and actions when trust and institutional tools fail			
Temporal dimension	Process of resilience enhancement	Approaching comprehensive (land/urban) scape renewal and identity affirmation as a single action Focusing on short-term benefits and disregarding long-term goals			

Tab.5 Models of fostering holistic natural risk resilience

Different resilience models establish the means through which cultural heritage and communities contribute to spatial planning in the course of disaster risk reduction. Therefore, spatial planning needs to promote holistic

natural risk resilience by strengthening and encouraging the integration of (land/urban)scape, cultural, identity, social, spatial, planning, economic, and other models that address multiple scales and temporal aspects of resilience (Chelleri et al., 2015).

Different interrelation structures that combine various models of natural risk resilience enhance spatial planning to develop beyond vulnerability assessment (ICOR, 2021; Dinshaw & McGinn, 2019; Borg et al., 2014), adaptability to disaster effects (ICOR, 2021; Chambers et al., 2019) and disaster recovery, restoration to the prior state and 'building back better' – towards the threshold concept to transform and 'build forward better' (Chelleri et al., 2015). Threshold concepts describe the core concepts that have to be mastered to think effectively from within a new paradigm (Loring, 2020). The roots of holistic resilience paradigm lie in international policies: the European Landscape Convention (Council of Europe, 2000; Council of Europe, 2016), European Green Deal (European Commission, 2019), Agenda for Sustainable Development (United Nations, 2015), and conventions recognizing the values of tangible and intangible cultural heritage for society (Council of Europe, 2005; UNESCO, 1972, 2003, 2019; European Commission, 2018) that exchange different perspectives towards the Hyogo Framework for Action 2005-2015 (UNISDR, 2005) and Sendai Framework for Disaster Risk Reduction 2015 – 2030 (UNISDR, 2015).

4.2 Implications of holistic natural risk resilience for spatial planning enhancement

Natural disasters destroy (land/urban) scape values, the protected cultural heritage, collective symbols and traditions, socio-cultural practices and networks, and have a direct impact on spatial resources that appeal to spatial planning with a view to enhancing the current resilience and reducing future risks. The Heritage Urbanism approach was applied to a historical overview of earthquake examples in the Apennine-Adriatic-Dinaride region and the most representative seismic events of the 21st century in Italy and Croatia were researched. The approach provided identifying factors and evaluation criteria and helped to read existing resilience models and form a new integrated model of holistic natural risk resilience. The implications of holistic natural risk resilience for spatial planning enhancement arise as the ultimate research conclusions.

Identifying factors in the natural disaster process derive from an exchange of (land/urban) scape dimensions and research aim. Perspectives on natural risk resilience that the spatial planning process should regard are based on extended identity factors of the natural disaster: 1. natural risk (natural disaster and area of influence); 2. cultural heritage (protected cultural heritage and (land/urban) scape heritage); 3. communities (collective meanings and local community); 4. spatial resources (professional initiatives and spatial management); and 5. spatial planning factors (existing spatial planning strategies and legal framework).

The evaluation criteria applied to a historical overview of the impacts of seismic activity on the Apennines-Po and Dinarides-Panonian regions, and the comparison of the Central Italy and Zagreb research cases include: 1. the three phases of the natural disaster process and 2. comprehensive challenges of natural disaster events regarding spatial planning. The established evaluation criteria show spatial planning to be a system that must function and guide progress through a stillness phase (pre-shock), emergency phase (shock), and recovery phase (aftershock) in the natural disaster process, and not as an ad-hoc reaction, adaptation to, or reduction of the destructive effects. Resilient spatial planning must address multiple spatial scales, multiple temporal aspects of resilience, various perspectives of natural disasters, and be integrated in all levels of spatial planning.

A comparison of the goals of different approaches to disaster resilience enhancement in Central Italy and Zagreb reflect local problems in dealing with the consequences of earthquakes, common threats that must be overcome, shared goals, and existing resilience models. Spatial planning can be enhanced by interrelating (land/urban) scape resilience dimensions and existing resilience models, thereby forming a new integrated holistic model. The holistic model therefore advances the values already present and develops an endogenous spatial planning approach. In the midst of constant risks from natural disasters, spatial planning should

promote holistic natural risk resilience by strengthening and encouraging the integration of resilience models regarding the (land/urban) scape, culture, identity, society, space, planning, economics, etc. Fostering holistic natural risk resilience is therefore needed as a standard in spatial planning, (land/urban) scape and urban renewal, cultural affirmation and social identity, developing hearty communities, all professional outputs, and hosted by everyone who participates in designing and planning cities, settlements, and landscapes.

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Image sources

Fig.1a: Italian Civil Protection Department (http://www.protezionecivile.gov.it/en/risk-activities/seismic-risk/emergencies/central-italy-2016);

Fig.1b: Marche Region Special Office for Reconstruction (https://www.regione.marche.it/Regione-Utile/Terremoto-Marche/SAE-soluzioni-abitative-in-emergenza#Mappa-aree-SAE);

Fig.2a: Google satellite;

Fig.2b: Ilenia Pierantoni, Massimo Sargolini;

Fig.3: Documento Direttore del Comune di Arquata del Tronto (commissioned by the Municipality of Arquata del Tronto to the School of Architecture and Design of the University of Camerino. Scientific coordinator: Prof. Giuseppe Losco. Scientific Responsible for landscape and territorial planning: Michele Talia);

Fig.4a: author Leon Ladišić;

Fig.4b: author Ana Sopina;

Fig.5: author Ana Sopina;

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