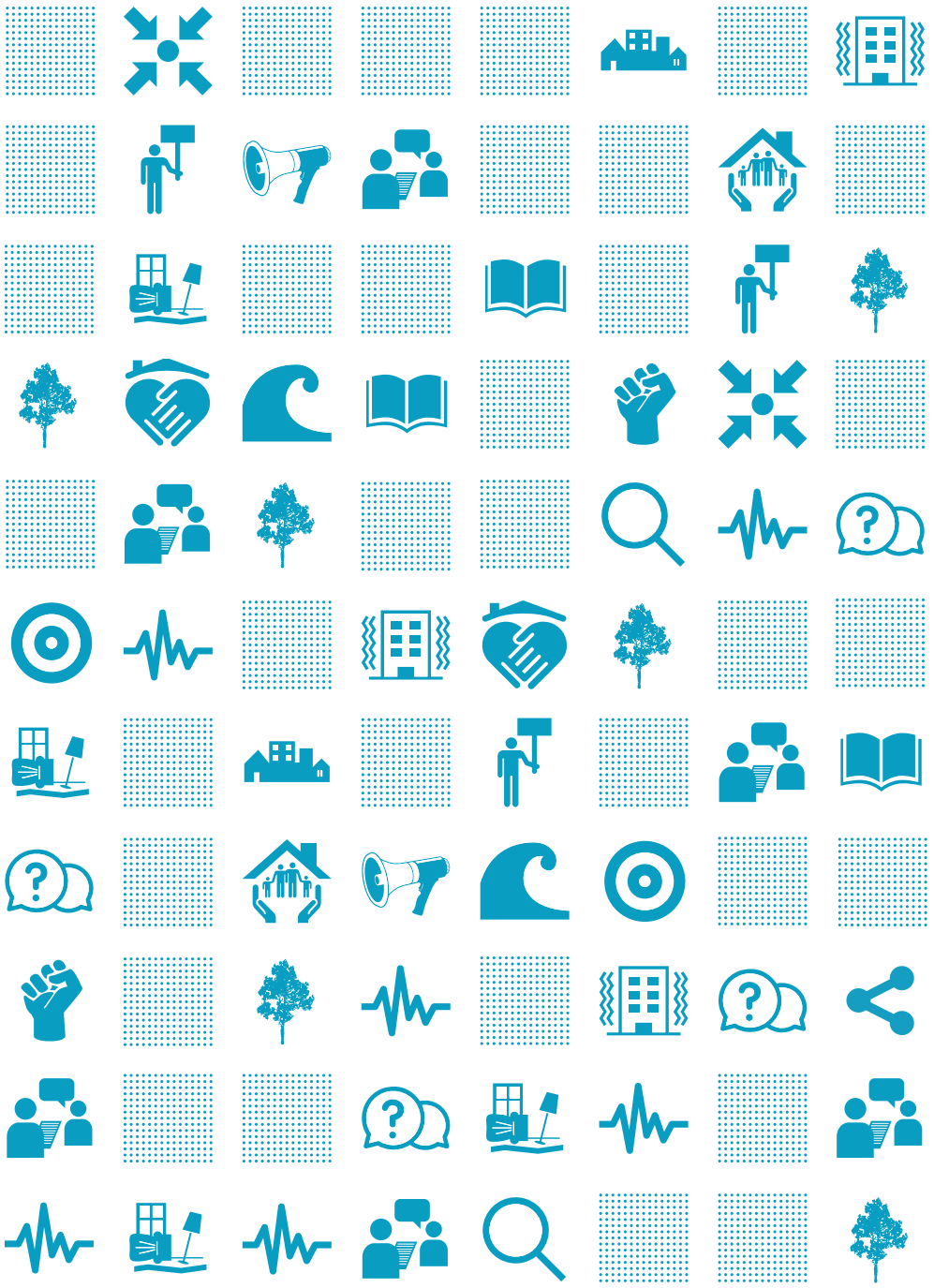


KEYWORDS

Risk: To be threatened by harm. To be at risk is to be under threat of harm.
Hazard: The potential to harm individuals or human systems. In this work, hazard is ascribed to natural, physical or environmental elements. It can be everyday (scarcity of clean drinking water) or episodic (volcanic eruption).
Vulnerability: Denotes exposure to risk and an inability to avoid or absorb potential harm.
Physical vulnerability: Vulnerability in the built environment.
Social vulnerability: Vulnerability experienced by people and their social, economic and political systems.
Human vulnerability: The combination of physical and social vulnerability.
Resilience: The capacity to adjust to threats and mitigate or avoid harm. Resilience can be found in hazard-resistant buildings or adaptive social systems.
Disaster: The outcome of hazard and vulnerability coinciding. Disaster is a state of disruption to systemic functions. Systems operate at a variety of scales, from individuals' biological and psychological constitutions or local socio-economies to urban infrastructure networks and the global political economy.
Threshold:
Adaptive cycle:

#resilientcities; #urbanresilience; #adaptation; #transitiontowns; #sustainability; #adaptivecycle; #social-ecologicalsystems; #earthquake

The relative density of residents, cultural institutions, and opportunities for commerce distinguishes cities, so recovery must also entail some sort of return to normalcy in the human terms of social and economic relations.

In some cases, where the toll of death and displacement has been high, the numerical resilience of the population may be a reasonable proxy for recovery. But, for others cities will judge recovery through different sorts of mindsets, conditioned by both professional training and by personal attachment to places and people. Economists will look toward restoration of economic activity; transportation planners will seek measures of local and regional traffic flows; designers will look for the healing of streetscapes and the advent of new buildings and memorials; psychologists, clergy, and schoolteachers will make assessments of emotional well-being. The process of post-disaster recovery is a window into the power structure of the society that has been stricken. Understanding the meaning of urban disasters therefore entails more than examining the various institutions every society sets up

WHAT DOES IT MEAN FOR A CITY TO RECOVER?

to manage recovery. These institutions—such as civil defence organizations, law enforcement agencies, charities, insurance brokers, and victims compensation funds—are certainly vital aspects of urban resilience.

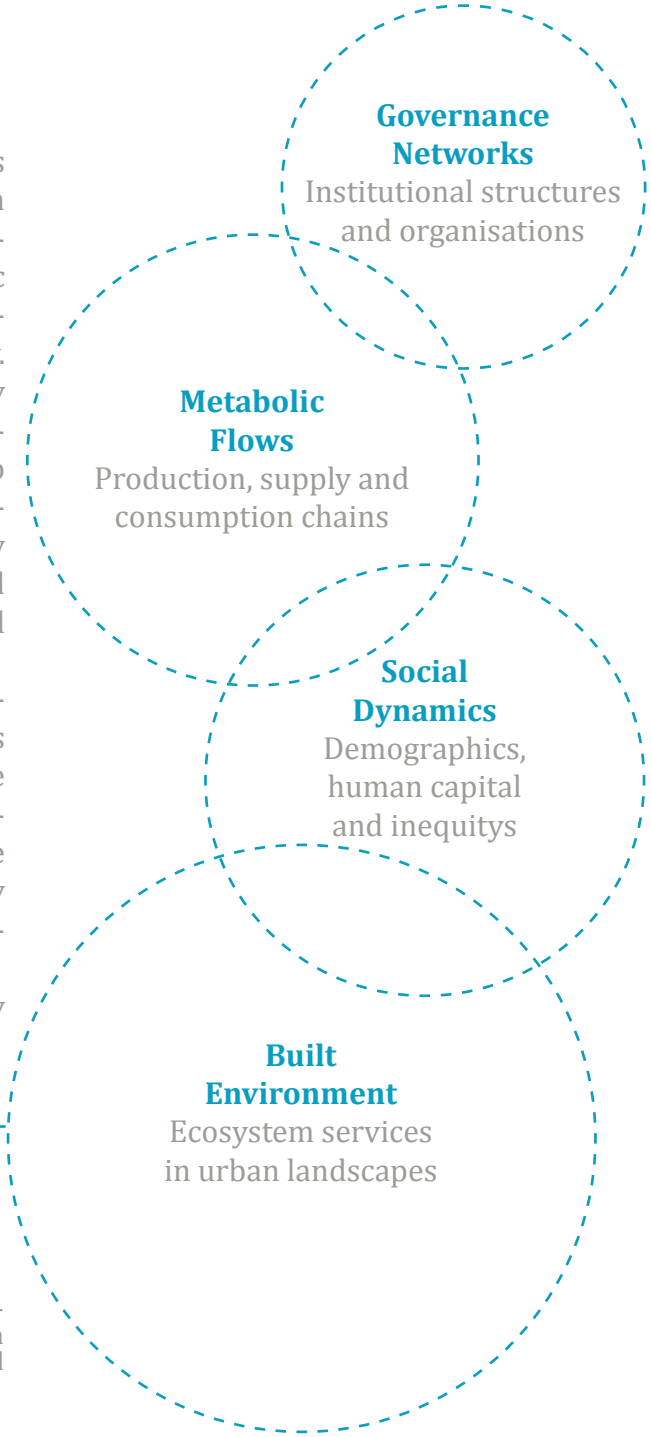
The impact of urban destruction is not necessarily proportional to the scale of attack.

The term resilient city is always coupled with an ongoing recovery process. The goal should be *productive openness*, an ability to structure and confront the contradictory impulses inherent in the contested processes of recovery and remembrance.

A traumatized city endures not only physical injury and economic hardship but also damage to its image. The perceived source of a given disaster also profoundly af-

fects urban resilience.

The city has been recognized as a weak and complex organism with different flows and dynamics, therefore the socio-economic consequences pervade any discussion of post-disaster recovery. Protracted socioeconomic decay makes urban resilience exceptionally difficult to sustain. No two cities have recovered in precisely the same way, as a variety of social, economic, and cultural factors determine the path and timing of the recovery process.
Accordingly, one of the most urgent tasks of reconstruction has been to try to make sense of the disaster, to discover (or establish) meanings that help people to recover a sense of mastery over their natural and social surroundings.
Recover does not necessarily mean rebuild.



The four themes interrelated in Urban Resilience Research

Source: Lawrence J. Vale, Thomas J. Campanella, The Resilient City How Modern Cities Recover from Disaster, Oxford University Press, 2005.

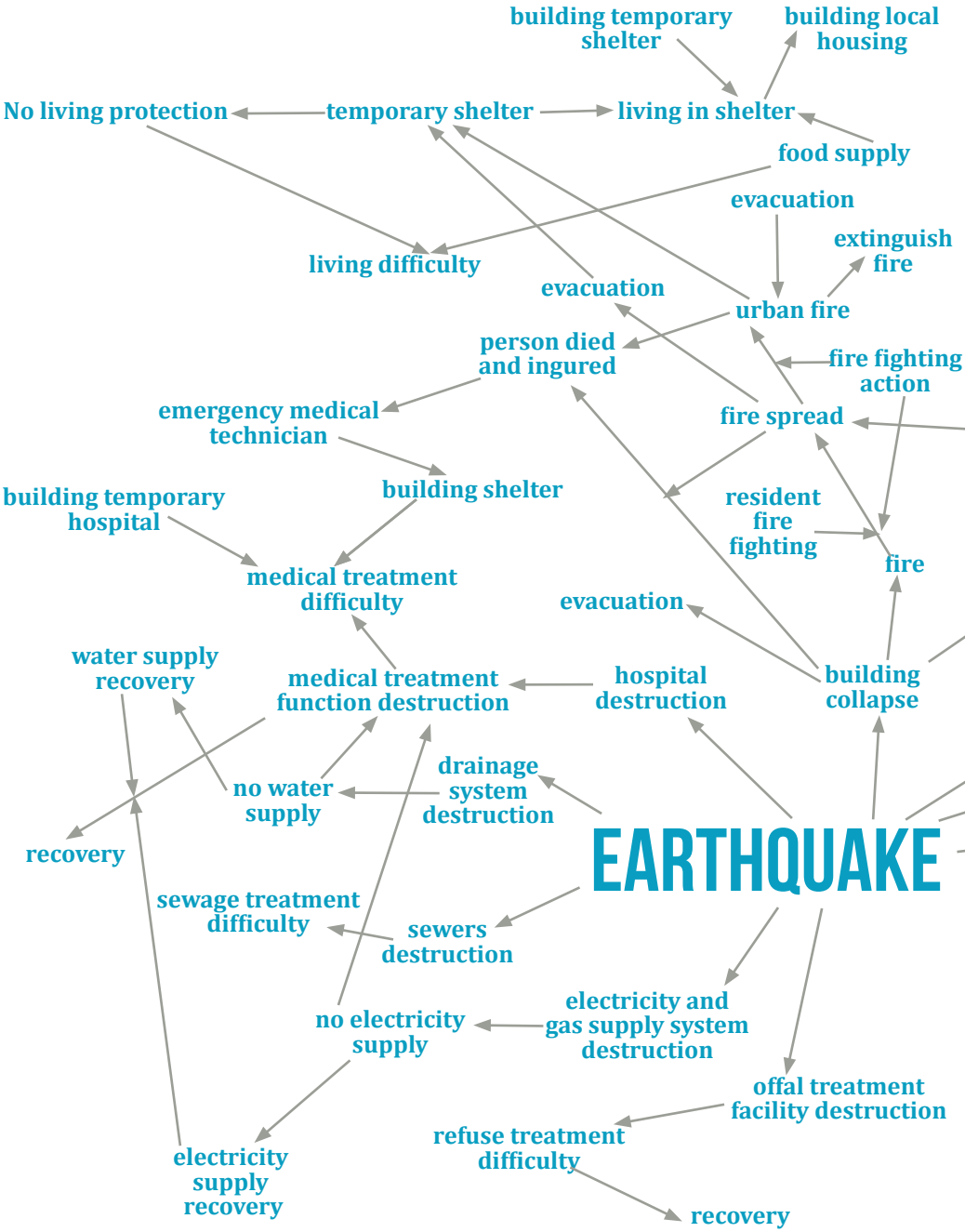
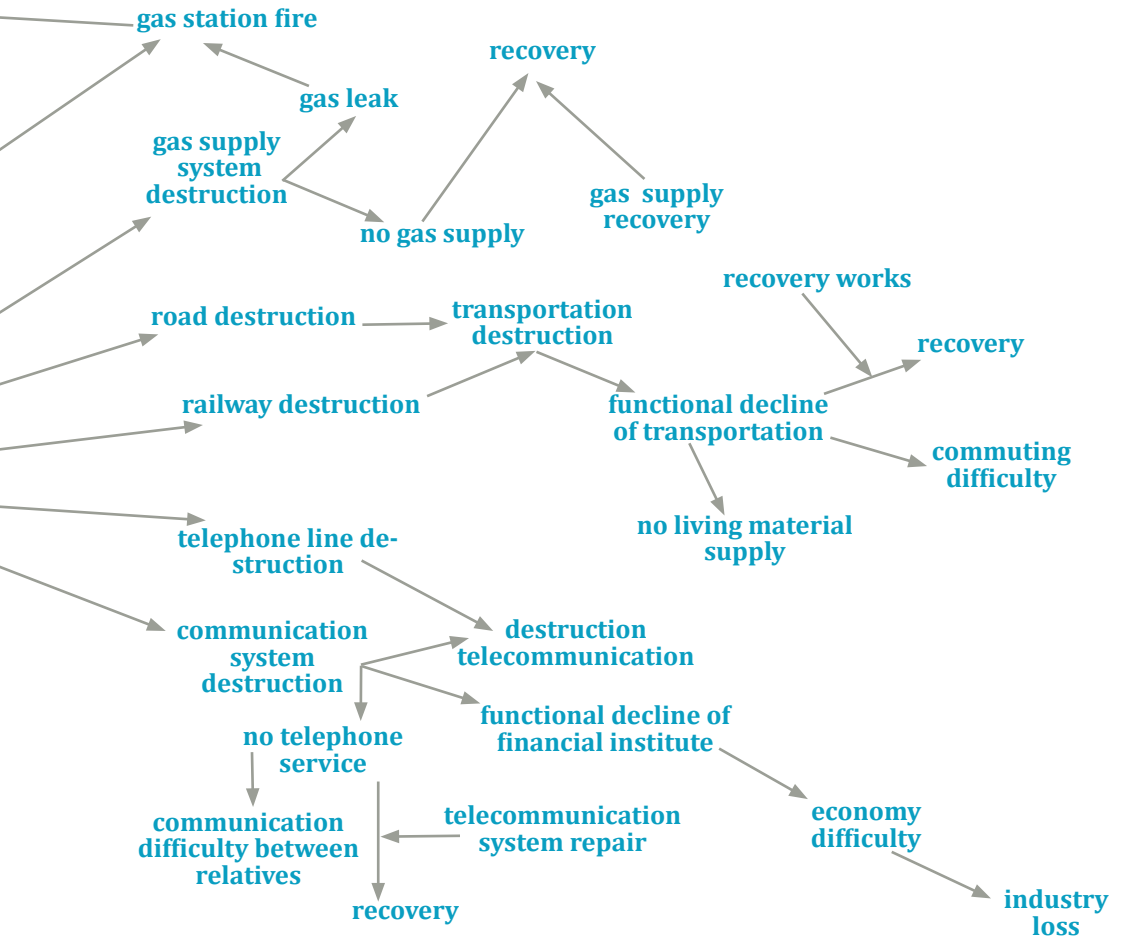


Figure 1.1 **Impacts of an earthquake**

Building resilience means, target driven approach to urban development that uses a wide range of measures addressing all elements of urban systems. Ensuring these targets are met demands all levels of communities and governments work together to ensure the safety of all people and protect the economic, social, environmental, and cultural assets and attributes which define the unique character of each city. Building resilience to disasters requires the political will and intervention of active, competent local governments, in the way to reduce the impacts of earthquake on the city.



APPROACHES OF RESILIENCE THEORY

From an engineering perspective, resilience is defined as the property of a specific material to absorb energy when it is deformed elastically and the recovery of this energy when returning to its original state (Stefano Avallone, 2007).

At the same time, from the literature on engineering resilience to focusing on the vulnerability of people and places, social resilience depends on hazardous environments, the forecasting of catastrophic events, and systemic breakdowns and their social and economic implications (Laurence Vale and Thomas Campanella, 2005).

This represents a way of thinking about safety in which resilience attempts to express or ensure that any organization maintains (or recovers to) a safe stable state, helping people to cope with complexity under pressure and therefore achieve success.

The concepts of **«maintaining»**, **«recovering»** and **«looking for equilibrium»** are key points of those different meanings and frameworks of resilience.

Ecosystem resilience (Crawford Holling, 1986) moved afterwards to include Social-Ecological System's (SESs), emphasizing the management dimension of this coupled system dynamics (Carl Folke , 2005).

The key step in this evolution is the shift from the recovery to the transformation principle in adapting to disturbance.

In fact, Holling defined resilience in ecosystems as the system's capacity of re-organizing and managing changes in order to maintain the same identity, structure and functions.

There are two main ways of resilience thinking theory (David Salt and Brian Walker, 2006): the first concerns **system's thresholds and regime domains**, while the second is represented by the heuristic model of **adaptive cycles**.

A threshold is defined as a crossing point into a system with many variables that tends to a naturally dynamic equilibrium state. The

concept of «regime» express all the possible system's movements within a basin of attraction. This dynamic equilibrium, inside a basin of attraction, can flip from one basin to another one and crossing a threshold, assuming different functions and structure (renewal and re-organization).

The concept of adaptive cycle is expressed as a dynamic cycle of growth (exploitation phase), conservation (steady state phase), collapse (release phase) and finally the reorganization phase.

This model emphasizes two essential messages from resilience theory: that disturbance is a necessary part of development and that renewal (learning and self-organization for change), much more than conservation or bouncing back, is a resilient strategy. These systems adaptations and transformations occur as multi-scalar and multi-equilibrium (spatial and temporal) processes. New approaches non-linearity, based on self-organization, influencing resilience theory.

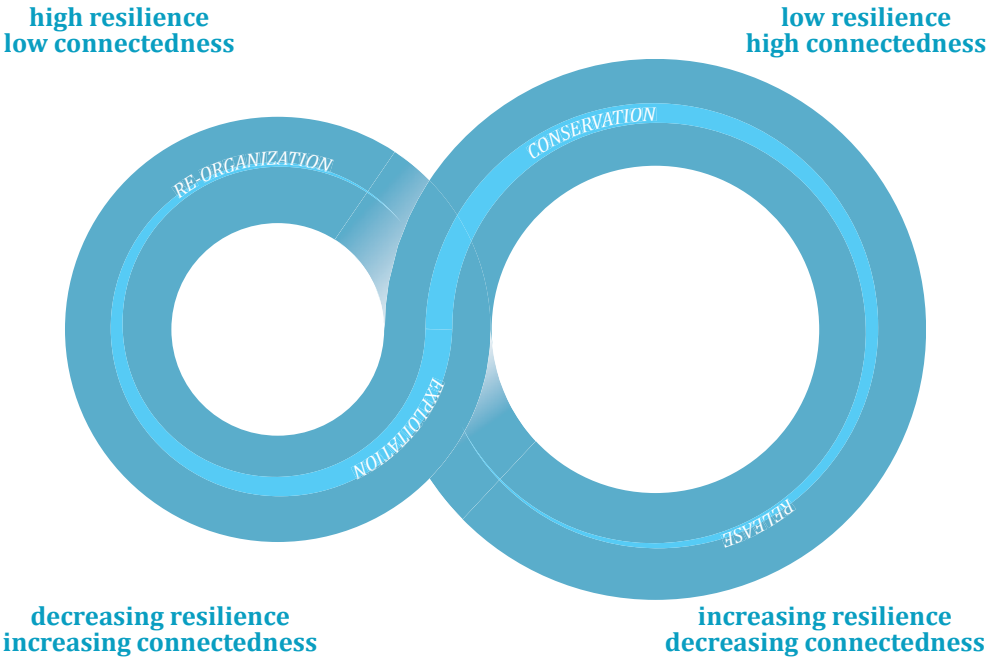


Figure 1.2 **Renewal Adaptive Cycle model.**
Source: Lance H. Gunderson, Crawford S. Holling, Panarchy: Understanding Transformations in Human and Natural Systems. Washington D.C.: Island Press, 2002.

RESILIENCE OR RESISTANCE?

Lawrence Vale and Thomas Campanella argued that the city was «the humankind's most durable artefact». In fact, as they said, despite «the cities were sacked, burned, bombed, flooded, starved, irradiated – they have, in almost every case, risen again like the myth of the phoenix»

As Lewis Mumford argued, before the metropolis «the city, the village, the cave and the cairn there was an essential disposition to social life. The city begins as a meeting place».

Resilience as resistance emphasizes that although time has dissolved some built structures, the social structures remained durable. It is the human and social living properties that make cities express, through the tenacity of the urban life. The city represents the maximum societal energy point in a territory, the place in which time and the human experience become visible throughout a process of power and cultural built symbols.

As in the adaptive cycle model, cities also evolve cyclically toward an ongoing process of destruction, redesign and reconfiguration. Some experienced trauma (earthquakes, wars, etc),

the narratives of disasters are permeated with a culture of optimism, in which resilience is a matter of political and social factors while urban rebuilding is a social-psychological need in order to make sense of the disaster. The conceptual step between the disaster-recovery process and the ongoing evolution of cities, it was studied from many authors, that have begun to build models attempting to explain fundamental principles of urban pattern dynamics and spatial self-organization.

Figure 1.3 **Global Supply Chain Resilience**
Source: http://www.flickr.com/photos/worldeconomicforum/8475171189/sizes/o/in/photostream/

MODEL OF RECOVERY ACTIVITY

disaster event

EMERGENCY RESPONSES

The emergency phase is marked by efforts to cope with the injured, with the loss of life, and with the presence of debris and is a period when normal social and economic activities cease or are drastically changed.
Depending on the scale of societal resources, this phase may last from a few days to many weeks. Its end is signalled by the cessation of search-and rescue operations, the drastic reduction in emergency mass feeding and housing, and the reopening of principal streets.

RESTORATION OF THE RE-STORABLE

The second period entails the re-establishment of major urban services, utilities, and transport, the return of those refugees intending to return, and substantial clearance of the rubble.
This phase, again depending on available resources, lasts from several months to more than a year.

It is a study of *Reconstruction following Disaster*, a project focused on natural disasters, which was sponsored by the U.S. National Science Foundation in the mid-1970s. Its team of researchers proposed and tested a *"model of recovery activity"* that classified the recovery process into four distinguishable stages: "

RECONSTRUCTION OF THE DESTROYED FOR FUNCTIONAL REPLACEMENT

The third phase is marked by the rebuilding of the capital stock to pre-disaster levels and the replacement of the population. In areas that suffer high death tolls, of course, such reference to a replacement population is no more than a statistical convenience, meant to signal that the area once again contains adequate housing, jobs, and amenities to support the pre-disaster population. During this period, these scientists and social scientists observed, social and economic activities return to pre-disaster levels or greater.

RECONSTRUCTION FOR COMMEMORATION, BETTERMENT AND DEVELOPMENT

These large projects, usually government-financed, serve three varied but sometimes interrelated functions :
to memorialise or commemorate the disaster; to mark the city's post-disaster betterment or improvement; or to serve its future growth or development.

THE DISASTER CYCLE IN AN URBAN CONTEXT

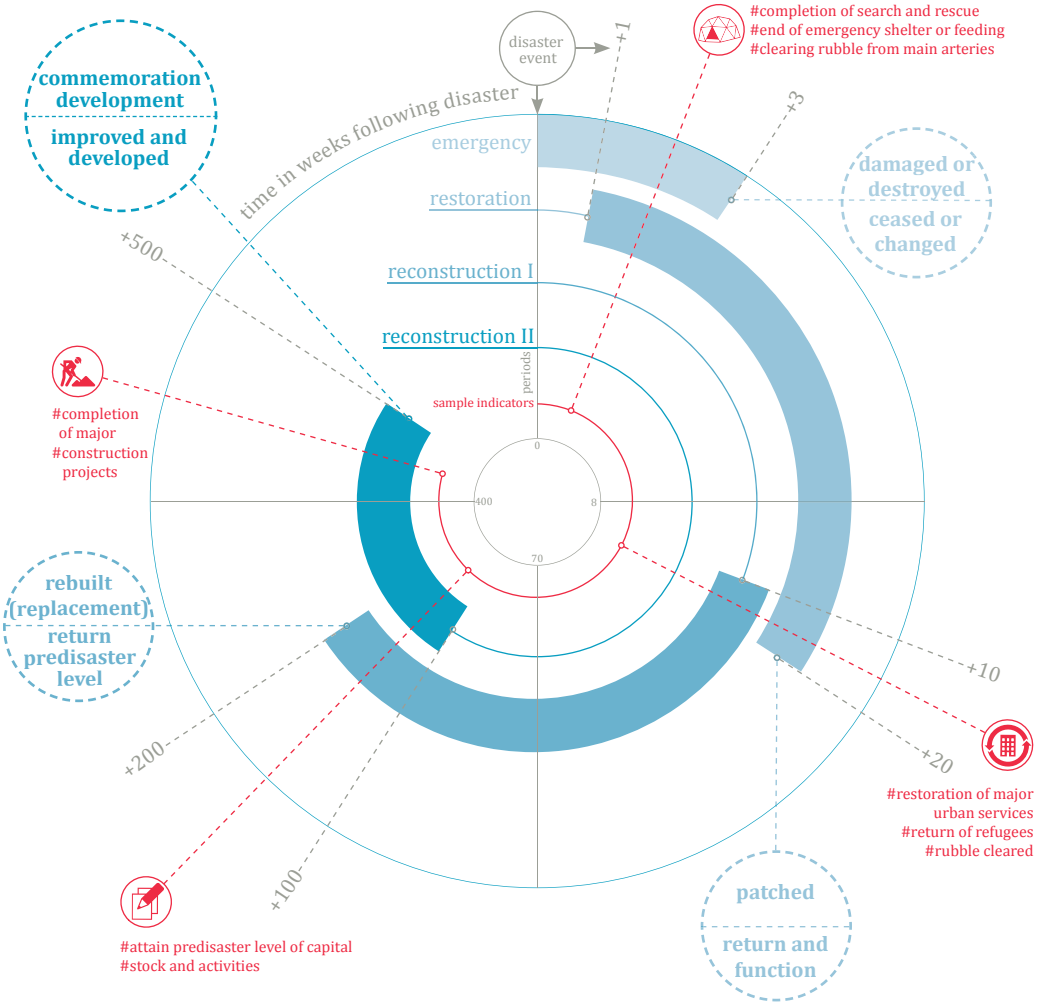


Figure 1.4 **A model of disaster recovery activity.**
Source: J. Eugene Haas, Robert W. Kates, Martyn J. Bowden, Reconstruction Following Disaster, MIT Press environmental studies series.

Immediately after the disaster, there is a short emergency phase, followed by progressively longer periods concerned with restoring basic services and physical, social, economic and psychological reconstruction.

The restoration part could be followed by longer time after the emergency phase, re-establishing main urban services, utilities and transport service .

Reconstruction should be into the next round of mitigation and preparedness work as systems learn from the event by adapting to reduce the likelihood of future events. Reconstruction phase introduced the concept of commemoration developed, *memorial response* in the wake of violence is an expression of resilience. Increasingly, memorial expression has become an immediate language of engagement, not just a language of commemoration.

Memorial expression helps people to transform bereavement, anger, fear, and resolve into an active communal grief that mournfully celebrates ongoing life, even if transformed.

Memorial expression tasks creators to ensure remembrance through significant memorial forms, since the danger of forgetfulness, even oblivion, is enduring. There is instability as well in the rhetoric of civic resilience, which bravely proclaims that just as those murdered will be intensely remembered through memorials, the cityscape will be intensely remembered through acts of civic renewal *(testimoniance)*. A revitalized city, it was thought, would be a most appropriate response to an act of mass murder. In urban systems all phases of the disaster cycle may be experienced simultaneously in different parts of the city. This may be because more than one disaster is unfolding at any given time or because of different rates of response to disaster (communities may become isolated by disaster impacts, slowing their recovery). When time and political and financial resources are limited there is a danger that restoration and reconstruction are drawn out or never fully completed, exposing vulnerable individuals and groups to additional hazard, or that pre-disaster conditions are simply replicated.

Source: Mark Pelling, The Vulnerability of Cities: Natural Disaster and Social Resilience, Earthscan Publications Ltd. 2003

SUSTAINABLE CITIES IN RECOVERY

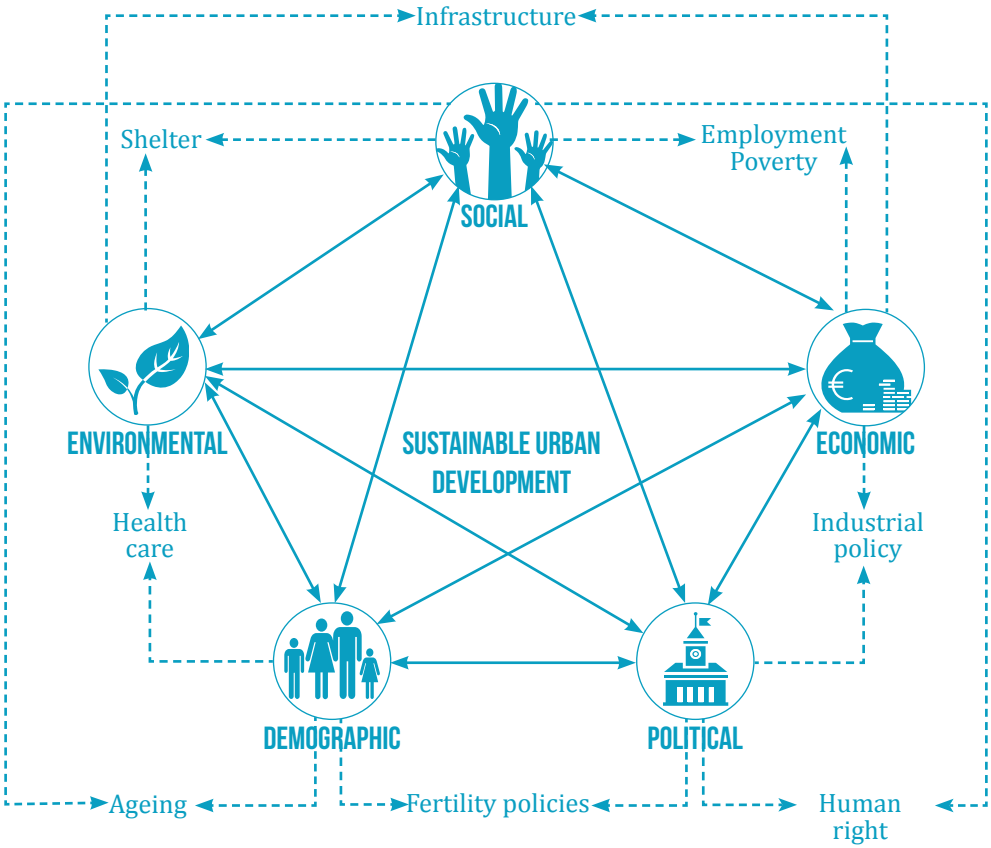


Figure 1.5 **Sustainable urbanization: main components and indicative issues**
Source: Mark Pelling, The Vulnerability of Cities: Natural Disaster and Social Resilience, EARTHSCAN Publications Ltd. 2003

The elements to be considered in such a holistic view of sustainable urbanization are five components identified as: social, economic, political, demographic and environmental.

This chart is useful in demonstrating the interconnectivity of the five components of sustainable urbanization and the need to place any policy to mitigate risk in the broader context of urban life as well as within larger regional and global physical and human systems.

Reorienting cities towards a vision of sustainability where environmental risk can be minimized places emphasis on the need for open and inclusive urban management set within a nested hierarchy of local, regional and international governance. Inside cities, municipal government occupies a pivotal position in its varied roles of service provider, community resource mobilizer, regulator, advocate and strategic planner. However, the capacity of municipal governments has very often been limited by financial and human resource scarcity and, especially in capital cities, by the capture of municipal responsibilities (and budgets) by central government.

Strengthening municipal authorities whilst broadening the base of urban governance by including civil society and private sector organizations should be a central concern for policymakers.

Some movement has been made in this direction, with international agencies and international non-governmental organizations (INGOs) as well as some national and city-level authorities prioritizing the institutional strengthening of city governments, urban poverty alleviation, family planning and community development.

Source: Mark Pelling, The Vulnerability of Cities: Natural Disaster and Social Resilience, Earthscan Publications Ltd. 2003

WHAT ARE 10 ESSENTIALS FOR MAKING CITIES DISASTER RESILIENT ?

Source:
United Nation International Strategy for Disaster Reduction. Making Cities Resilient: *"My city is getting ready"*

1. Put in place **organisation and coordination** to understand and reduce disaster risk, based on participation of citizen groups and civil society. Build local alliances. Ensure that all departments understand their role in disaster risk reduction and preparedness.

2. **Assign a budget** for disaster risk reduction and provide incentives for homeowners, low in come families, communities, businesses and the public sector to invest in reducing the risks they face.

3. Maintain up to date data on hazards and vulnerabilities, prepare **risk assessments** and use these as the basis for urban development plans and decisions, ensure that this information and the plans for your city's resilience are readily available to the public and fully discussed with them.

4. Invest in and maintain critical **infrastructure** that reduces risk, such as flood drainage, adjusted where needed to cope with climate change.

5. Assess the safety of all **schools and health facilities** and upgrade these as necessary.

6. Apply and enforce **realistic, risk compliant building regulations and land use planning principles.** Identify **safe land for low income** citizens and upgrade informal settlements, wherever feasible.

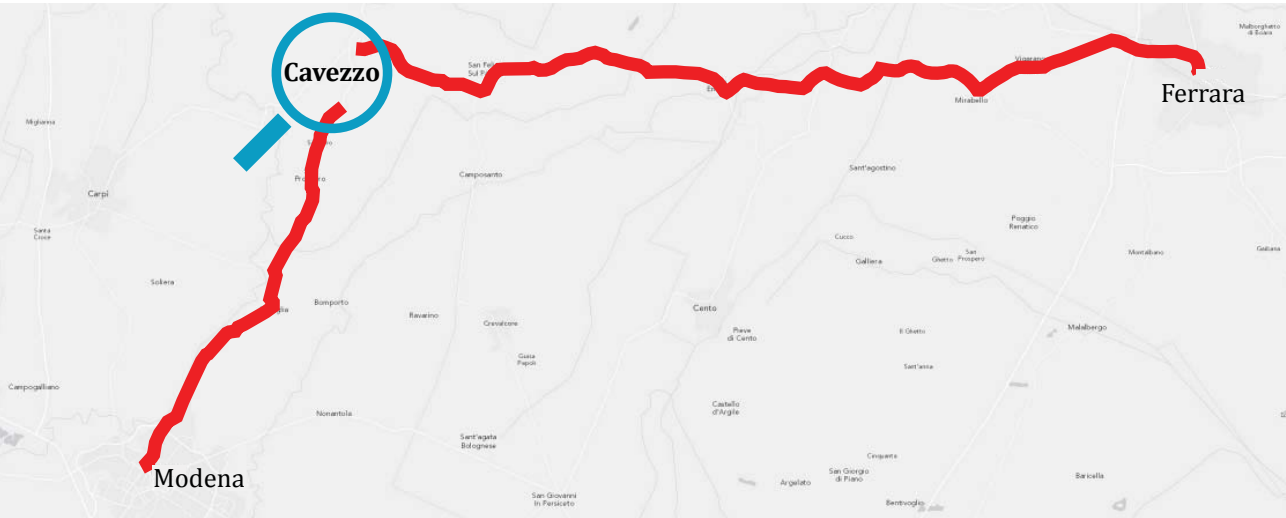
7. Ensure that **education programmes and training** on disaster risk reduction are in place in schools and local communities.

8. **Protect ecosystems and natural buffers** to mitigate floods, storm surges and other hazards to which your city may be vulnerable. Adapt to climate change by building on good risk reduction practices.

9. Install **early warning systems and emergency management** capacities in your city and hold regular public preparedness drills.

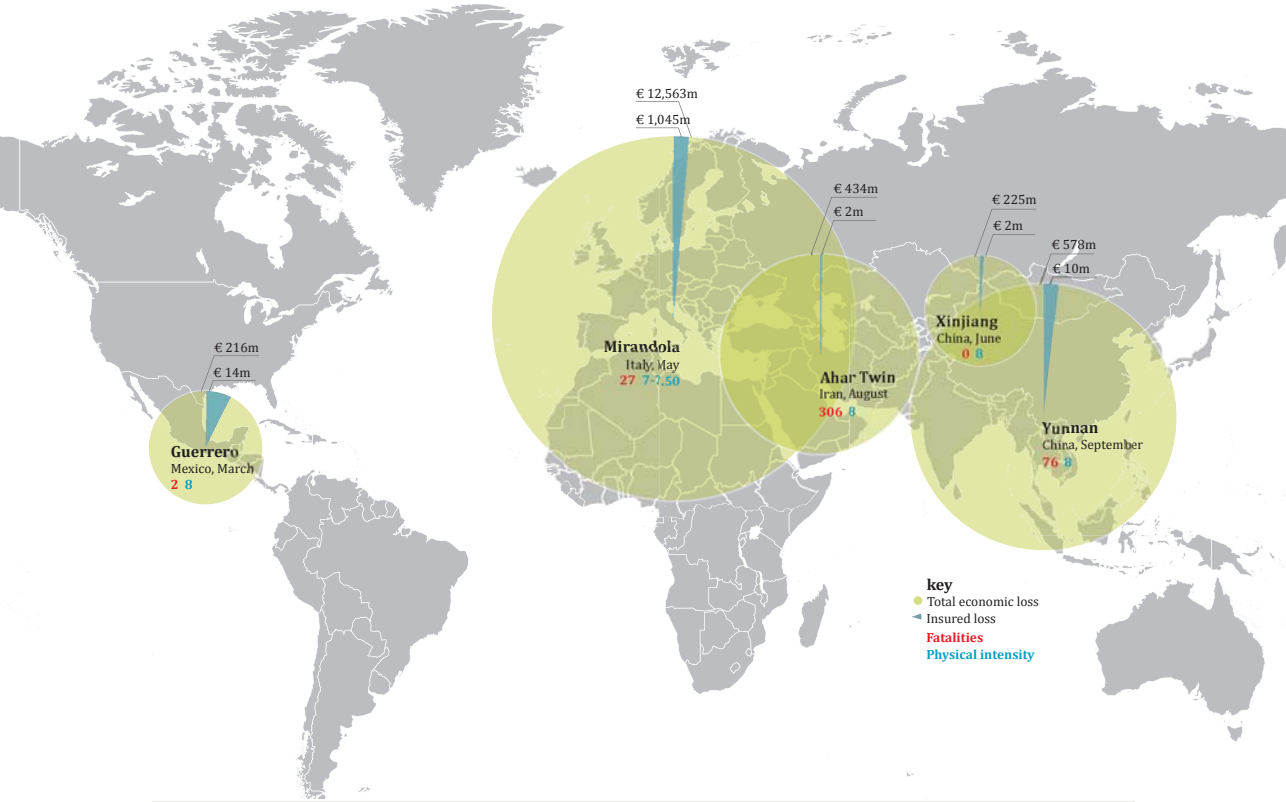
10. After any disaster, ensure that the **needs of the affected population are placed at the centre of reconstruction,** with support for them and their community organisations to design and help implement responses, including rebuilding homes and livelihoods.

GENERAL FRAMEWORK



M 6.1 AND M 5.9 NORTHERN ITALY ON MAY 20TH AND 29TH 2012

2012 DAMAGING EARTHQUAKES IN NUMBERS

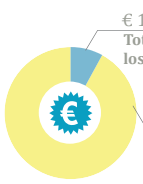


97+ Damaging earthquakes

CHINA 19, TURKEY AND INDONESIA 11

Countries with the most damaging earthquakes

690–727 Total fatalities (estimates)



CATDAT's definition of a "damaging earthquake":

- Any earthquake causing death, direct injury or homelessness.
- Any earthquake causing damage or flow-on effects exceeding 105,000 international dollars.
- Any earthquake causing disruption to a reasonable economic or social impact, as deemed appropriate

Figure 2.1 **Damaging Earthquakes in 2012**

Source: James Daniell, Armand Vervaeck, CATDAT - Integrated Historical Global Catastrophe Database, Damaging Earthquakes Database 2012 - The Year in Review, EDIM - http://earthquake-report.com/

A 5.9M_w earthquake hit the Emilia Romagna region of Italy on the 20th May 2012, resulting in 27 deaths, significant damage to historic structures, churches and industrial buildings, and 7000 people needing shelter.

Economic losses in 2012, on the other hand, were dominated (>85%) by the Italian earthquakes in Emilia Romagna.

The final loss estimate for direct losses by the Italian government for the earthquake sequence is upwards of 13.273 billion EUR (17.4 billion USD), which is comparable to the Aquila earthquake of 2009.

40752 workers have been laid off as a result of the earthquake. Of this damage, 12.202 billion EUR occurred in Emilia-Romagna, 980 million EUR in Mantova and 51 million EUR in Rovigo. Other minor damage occurred in other locations.

The affected area in Emilia-Romagna produced a GDP (Gross Domestic Product) value added in 2011 of 19.6 billion EUR, and exports totalling around 12.2 billion EUR.

For the 2012 earthquake, with downtime and businesses affected – a loss of 3.1 billion EUR in value added products was estimated. On the basis of damage to structures, warehouses and systems, the **loss** was equal to 2.7 billion EUR in the **biomedical sector and the textile industry.** In addition of the other industry, the loss in the **agricultural** and **livestock industry**, where 13735 businesses or concerns have been affected, totals around 2.2 billion EUR for agricultural sector.

The province of Modena accounted for 91.5% of this damage. 3.3 billion EUR **damage** occurred to around 34000 **residential buildings** of the 63000 that were checked for damage through AEDES. Damage to **schools and the education industry** will total over 100 million EUR. Out of 963 schools, 206 were red flagged.

In the **health industry,** around 96 million EUR damage occurred (57 million EUR damage and 39 million EUR temporary measures).

The **hydraulic system** and remediation has damage of around 72 million EUR. 2100 structures of historical and architectural significance had damage totalling 2.07 billion EUR.

Source**:** James Daniell, Armand Vervaeck, CATDAT - Integrated Historical Global Catastrophe Database, Damaging Earthquakes Database 2012

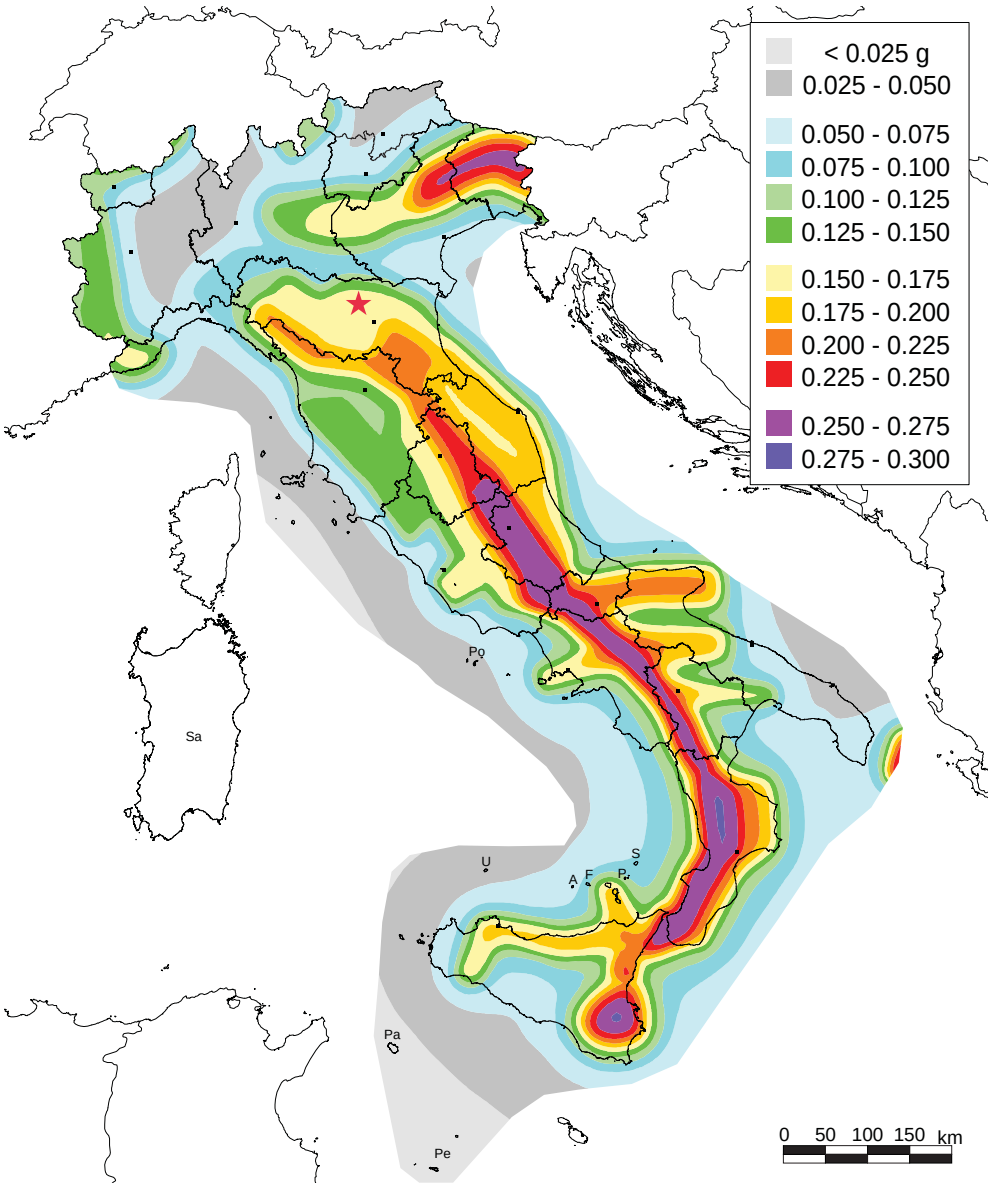


Figure 2.2 **Seismic hazard map of the country**
Source**:** Map prepared by INGV (Istituto -Nazionale di Geofisica e Vulcanologia)

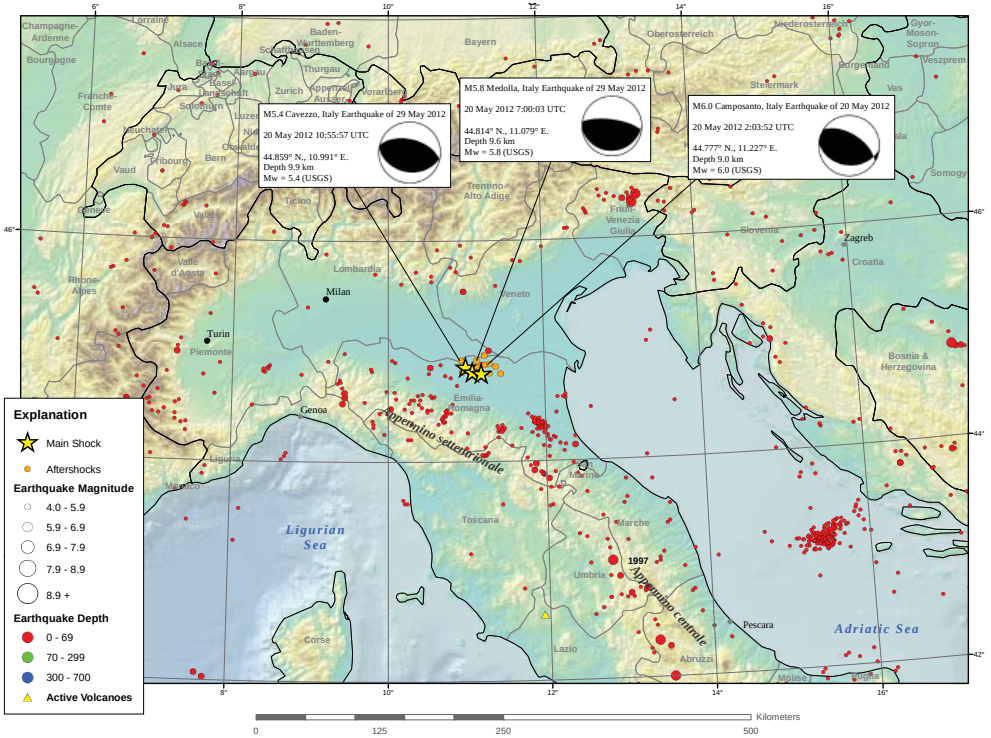


Figure 2.3 **Epicentre Region**

Source: Map prepared by U.S. Geological Survey National Earthquake Information Centre 29 May 2012

The May 20 and 29, 2012, earthquakes were felt through the whole of northern and central Italy, and as far as Switzerland, Slovenia, Croatia, Austria, south-eastern France and southern Germany.

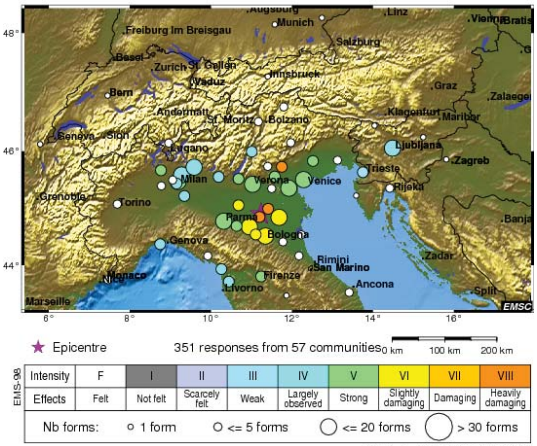


Figure 2.8 **Intensity map computed for the May 20th 2012 event**

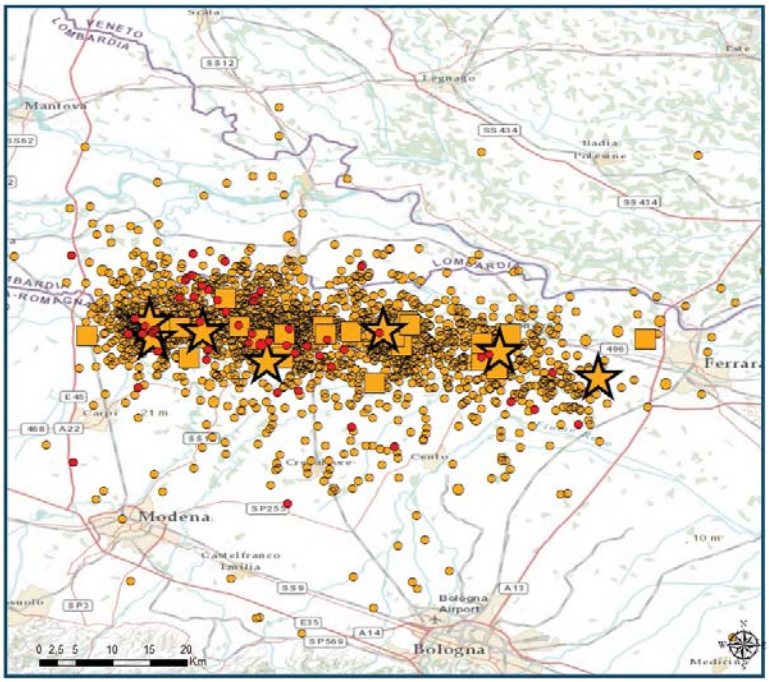
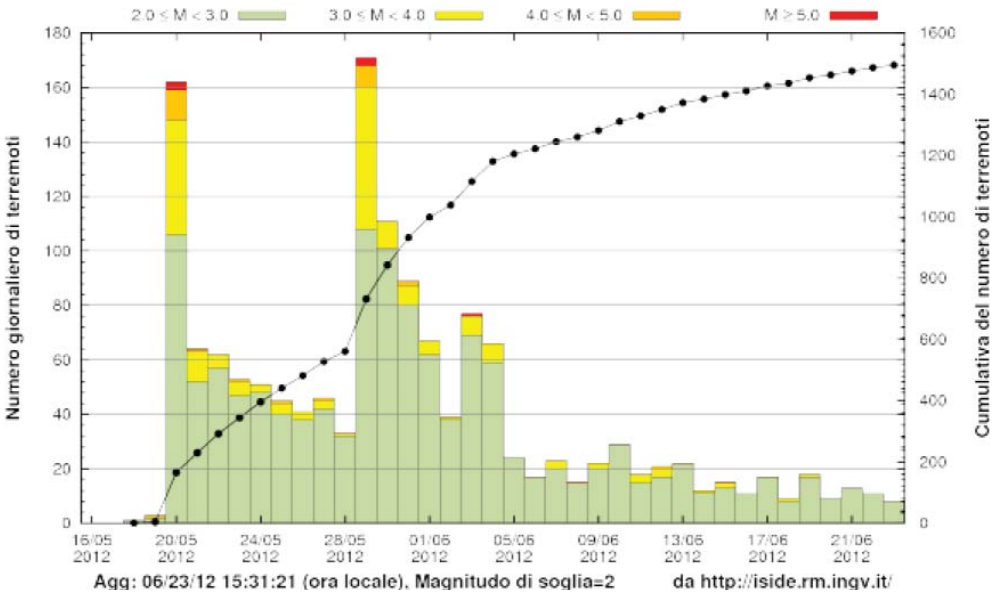


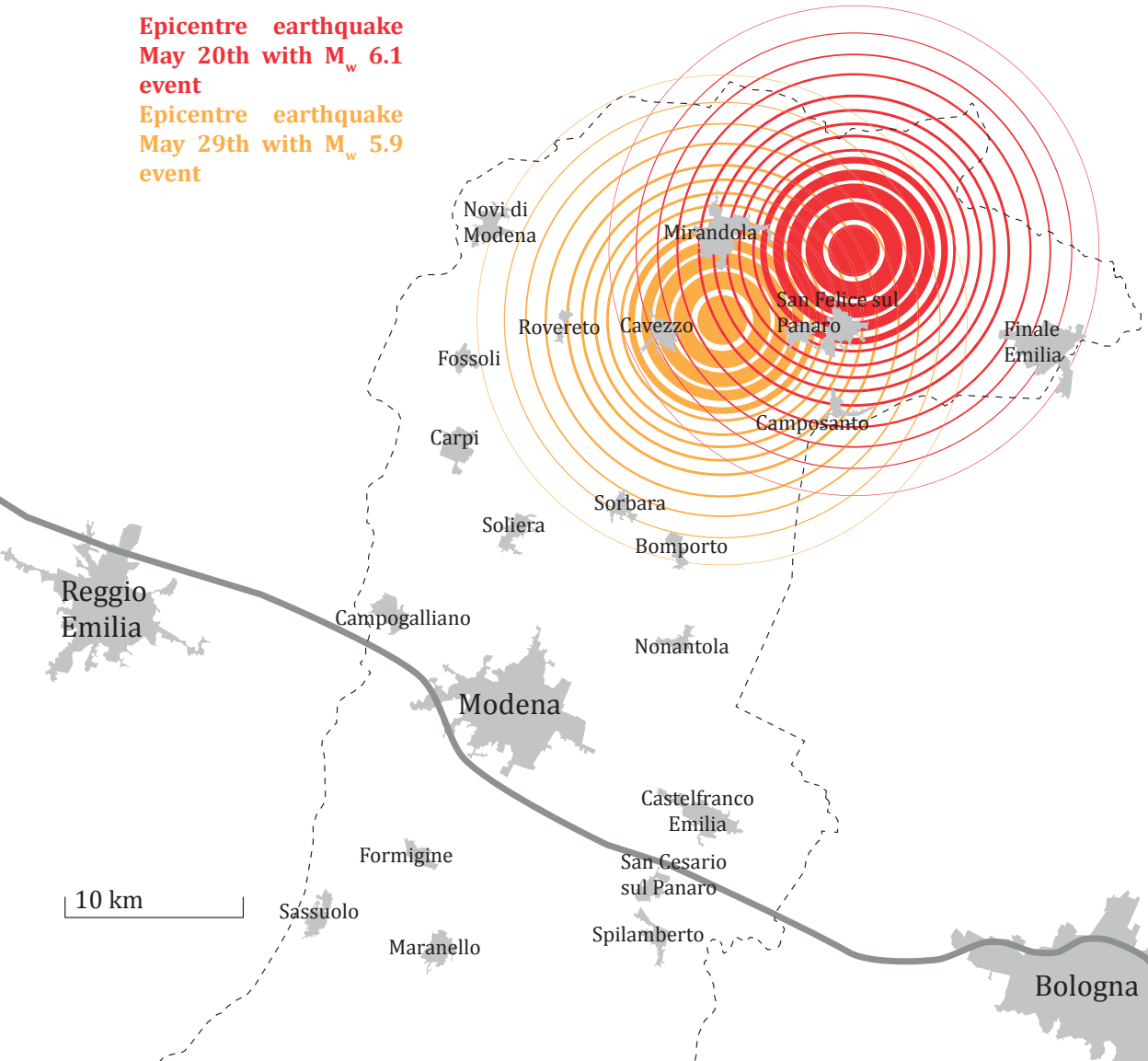
Figure 2.6 **Seismic sequence updated to June 10**
Source: Map prepared by INGV (Istituto Nazionale



EARTHQUAKE EPICENTRE

At 04:03 on Monday May 20th, an earthquake with magnitude M_W = 5.9 struck the region of Emilia Romagna in northern Italy with an epicentre approximately 30km west of Ferrara. Over one week later at 07:00 on Tuesday May 29th, an earthquake of magnitude M_W = 5.9 occurred with an epicentre 15km to the west of the first main event.

Figure 2.7 **Epicentres Location**

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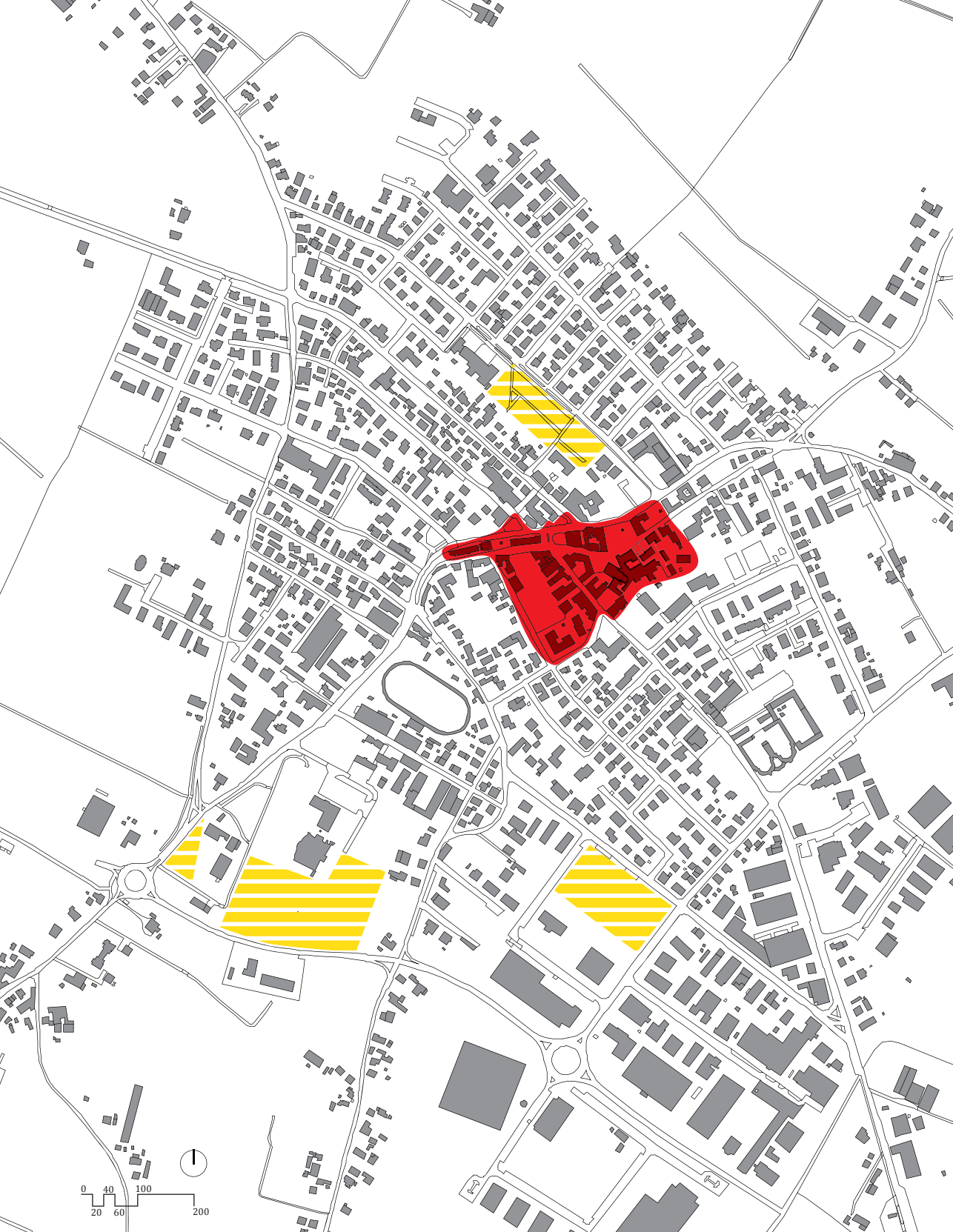
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TEMPORARY URBAN SPACE


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Via Curiel
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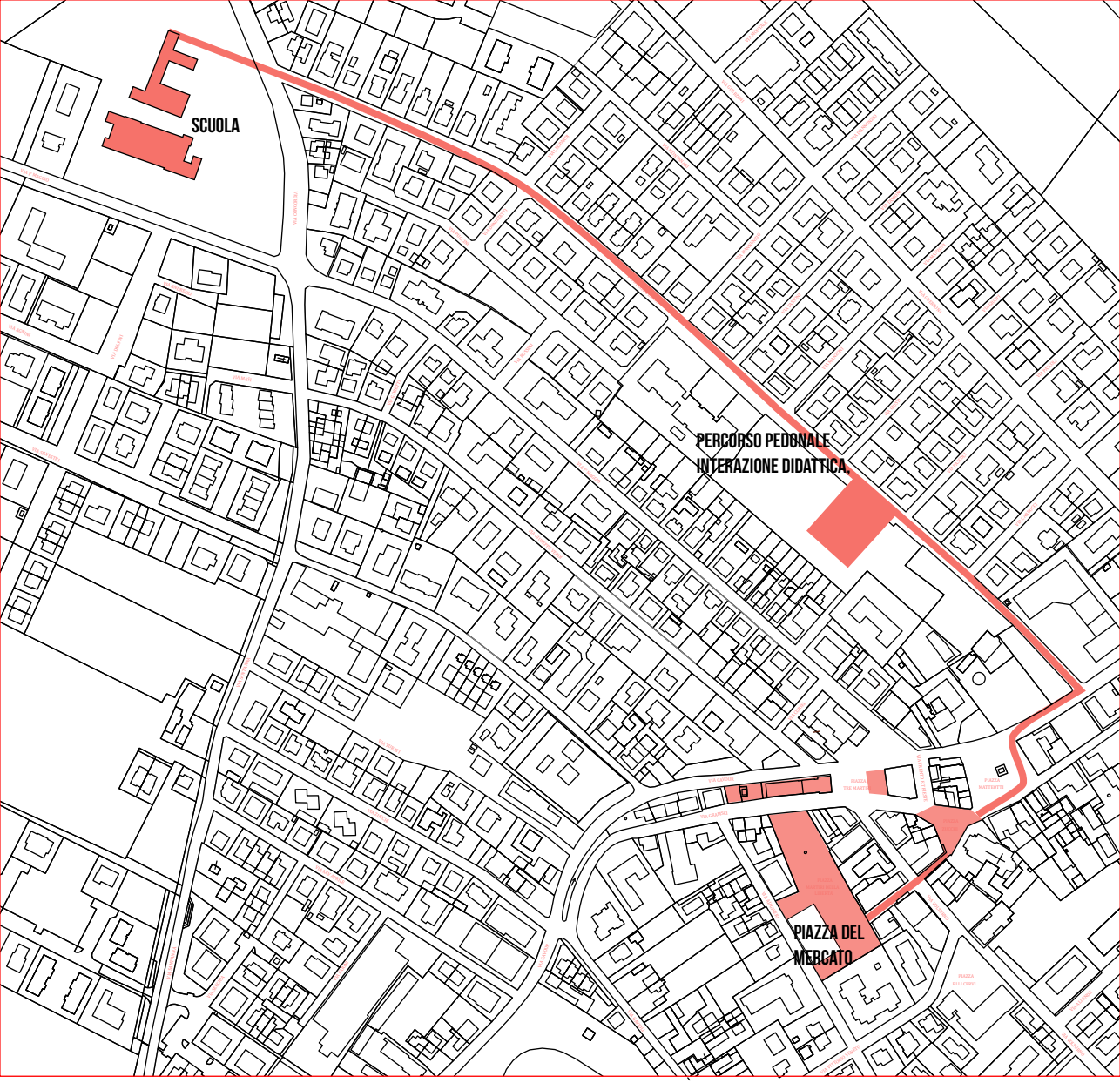
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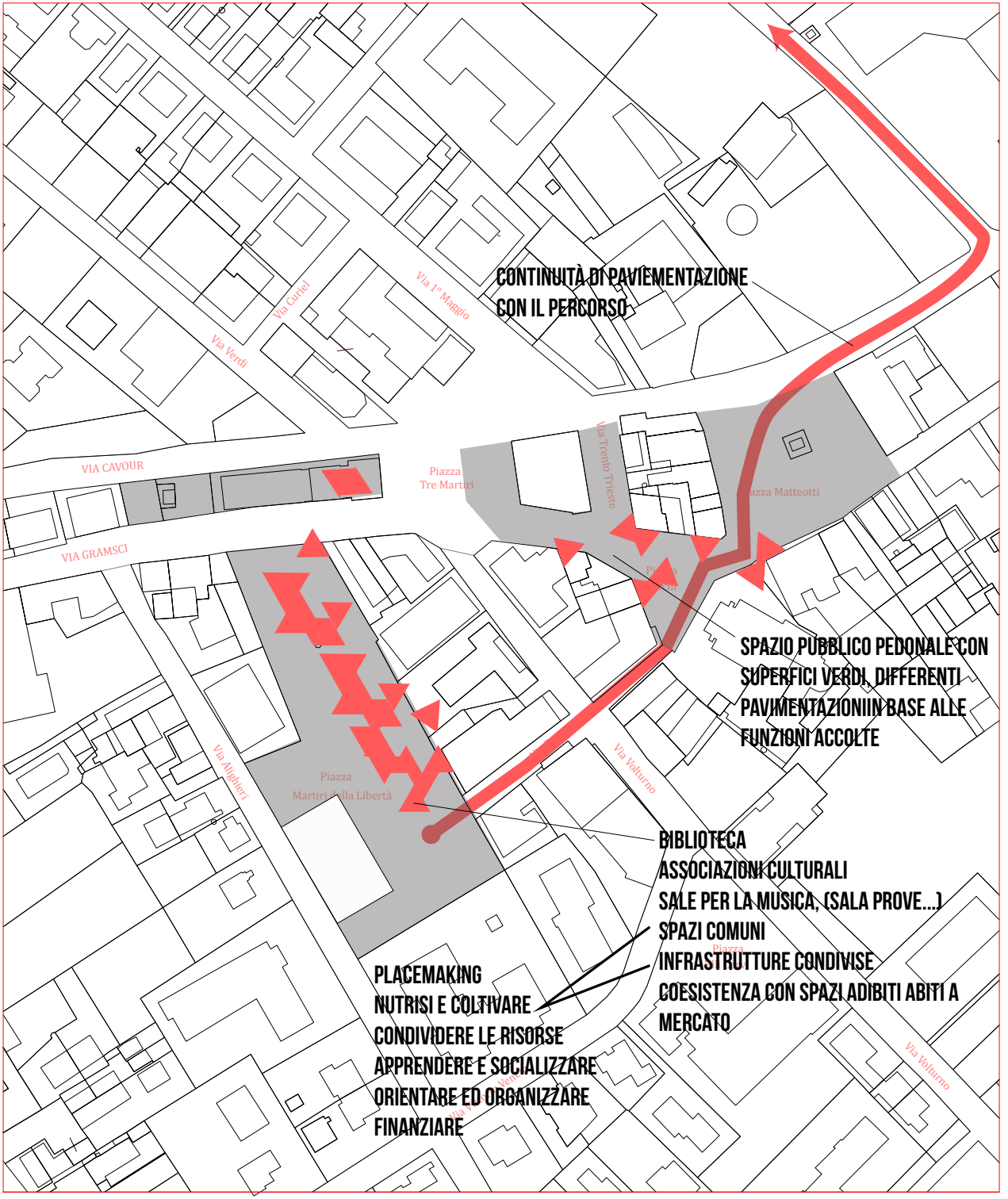
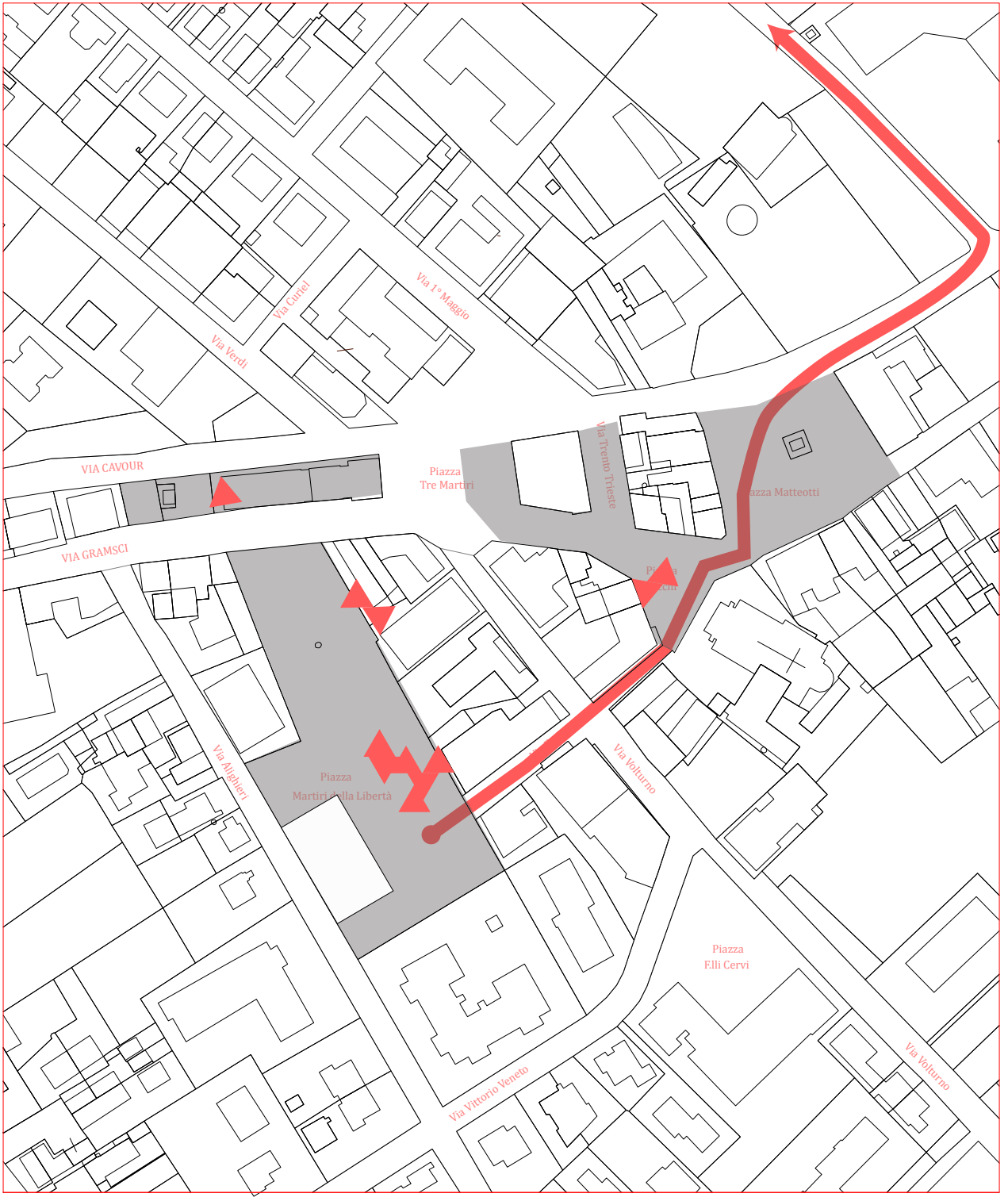
PIAZZA DEL
MERCATO


CONTINUITÀ DI PAVIEMENTAZIONE
CON IL PERCORSO
Via 1° Maggio
Via Curiel
Via Verdi
VIA CAVOUR
VIA GRAMSCI
Piazza
Tre Martiri
Via Trento Trieste
Piazza Matteotti
SPAZIO PUBBLICO PEDONALE CON
SUPERFICI VERDI, DIFFERENTI
PAVIMENTAZIONIIN BASE ALLE
FUNZIONI ACCOLTE
Via Alighieri
Piazza
Martiri della Libertà
Via Volturno
BIBLIOTECA
ASSOCIAZIONI CULTURALI
SALE PER LA MUSICA, (SALA PROVE...)
SPAZI COMUNI
INFRASTRUTTURE CONDIVISE
COESISTENZA CON SPAZI ADIBITI ABITI A
MERCATO
PLACEMAKING
NUTRISI E COLTIVARE
CONDIVIDERE LE RISORSE
APPRENDERE E SOCIALIZZARE
ORIENTARE ED ORGANIZZARE
FINANZIARE
Via Volturno


Via Curiel
Via 1° Maggio
Via Verdi
VIA CAVOUR
VIA GRAMSCI
Piazza
Tre Martiri
Via Trento Trieste
Piazza Matteotti
Via Alighieri
Piazza
Martiri della Libertà
Via Volturno
Piazza
F.lli Cervi
Via Vittorio Veneto
Via Volturno