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From fragile to resilient territories: the reconstruction after earthquakes in Central Italy

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Increasing resilience is a necessary part of the risk coping and management strategies; it may involve vulnerability reduction, including disaster prevention and mitigation measures at community levels. It can also be regarded as one of the most stressful and frustrating tasks for both community members and urban planners. The latter, along with local administration representatives, are working under great stress as long as emergency management is concerned. It makes it either neglected or insufficient. Communities, on the other hand, hardly ever perceive the risk they are facing by living in disaster-prone areas. In this context, the paper presents a multidisciplinary approach and cross-sectional collaboration that allow successful reconstruction process. The importance of risk information, communication and management in order to help communities to utilize their urban spaces in a more playful and proactive way in an emergency are highlighted. The approach is primarily the one of a self-experience reflection, and the case studies are introduced in order to expand the discussion on disaster-resilient communities and how to build them.

1. Reshaping consideration of disaster recovery

The history of human settlement in Italy dates back to the period of the Roman civilization. Many Italian cities are rich with priceless world heritage sites. However, the geography of this country located in the earthquake-prone zone makes dwellers and the heritage sites at risk of earthquakes that could lead to another consequent disaster, such as landslides and volcano eruptions. In addition, this risk is increased by an uncontrolled urban expansion into areas vulnerable to disaster, thus making disaster risk management even harder to achieve. Failures and successes of recent urban restoration from multi-hazard events should become a lesson to be learned for setting a code of conduct for disaster risk managers and urban planners.

Nevertheless, best practices from the other countries may not be suitable to adapt in Italian cases due to complexity of multi-hazard risk along with different context of social structure. Nowadays, Italy faces challenges of ageing society, silver economy and a great deal of investment in conservation and restoration of heritage sites leading to a slowdown in urban development, in another word: "urban decay". Surprisingly, disaster recovery caused by unusual circumstance opens a way out to urban restoration and revitalization after a disaster. Thus, urban developers and planners are entering to a new era of transforming vulnerable spaces, spatial features and urban infrastructure to be more resilience. Disaster recovery should not focus merely on a conventional reconstruction plan taken literally as "rebuilding as it was", but it should rather be reframed with a consideration of "transforming a fragile urban fabric into a better place to live with a risk". Therefore, it is necessary for an urban planner to work under the disaster risk management framework, turning disaster recovery in a sense of reconstruction to a sense of restoration and revitalization.

Ambiguities of key term: resilience

However reducing urban vulnerability and increasing resilience are crucial for this discourse, the very concepts of vulnerability and resilience are hard to define. We are facing ambiguities and doubtfulness on connotation of those key terms. It seems that over the time, risk management has moved from „reaction" resulting from vulnerability reduction schemes towards „adaptation" through increasing resilience. However, what does it mean to increase resilience remains unclear for the concept itself is ambiguous as interpretation of resilience must not be reduced to surviving a catastrophe. But the controversial issue of this shift is rooted in the ambiguity in determining resilience: either the concept of urban resilience has a generalized output and definite urban forms as a final product transferable to another case, or it is a progressive process of urban transformation without a definite final form to pursue. The early idea of definite form is generalized by a misconception that “increasing resilience decreases vulnerability” where resilience assessment is limited by a technical definition and a narrow set of indicators, which is the reverse of the fragility or vulnerability index – a restrictive approach focusing on ability to withstand a shock. To define resilience using only static parameters and static criteria is more than presumptuous: it is inefficient. The concept of urban resilience is wider than a focus on physical characteristic as it focuses on qualities of functional interaction between physical elements of human settlement and social structure that builds the city. Therefore, the resilience is not only about ability to resist shock, but also a capability to keep the essential urban activities operational and to recover in a timely manner. (Promsaka and Rizzi, 2013, 2014)

This should be acknowledged that “to rebuild as it was” does not necessarily indicate the success of a disaster recovery based on an urban resilience aspect. It is important to note that even resilience does acknowledge vulnerability in a sense of steadiness of physical elements and that increasing resilience does not always mean to decrease vulnerability. Similarly to a non-resilient urban system doesn't have to be vulnerable. A restoration and revitalization process of a disaster recovery rooted in the principles of resilience requires both self-organising and re-organising capacities in order to allow adaptation to stress and changes. As long as communities in a disaster-prone area perceive their risk and keep increasing their adaptability, their risk awareness will foster them to stimulate innovative strategies to live with risk. Such innovative restoration strategies shall increase resilience without losing the traces of the past. The future city depends on how well we take this situation as an opportunity to re-shape it.

2. The conceptual model of urban resilience to disaster

A conceptual model of urban resilience to protect against disaster risk is interpreted as both an outcome, and a process of disaster preparedness and recovery. This recovery should be considered a restoration process rather than a regular reconstruction. Whereas urban resilience to natural disaster means that components of urban system - built and natural environment, human capital, and socio-economic activities - are able to withstand disaster impacts without qualitatively losing its basic functionalities and physical structures that are necessary to maintain livelihood of their users. Urban resilience as considered here is the dynamic process that shifts urban systems from vulnerable to resilient, and then advances into innovative urban transformation. Nevertheless, this active movement requires sufficient adaptive capacities and a better social learning process as a set of catalysts to a resilient urban transformation

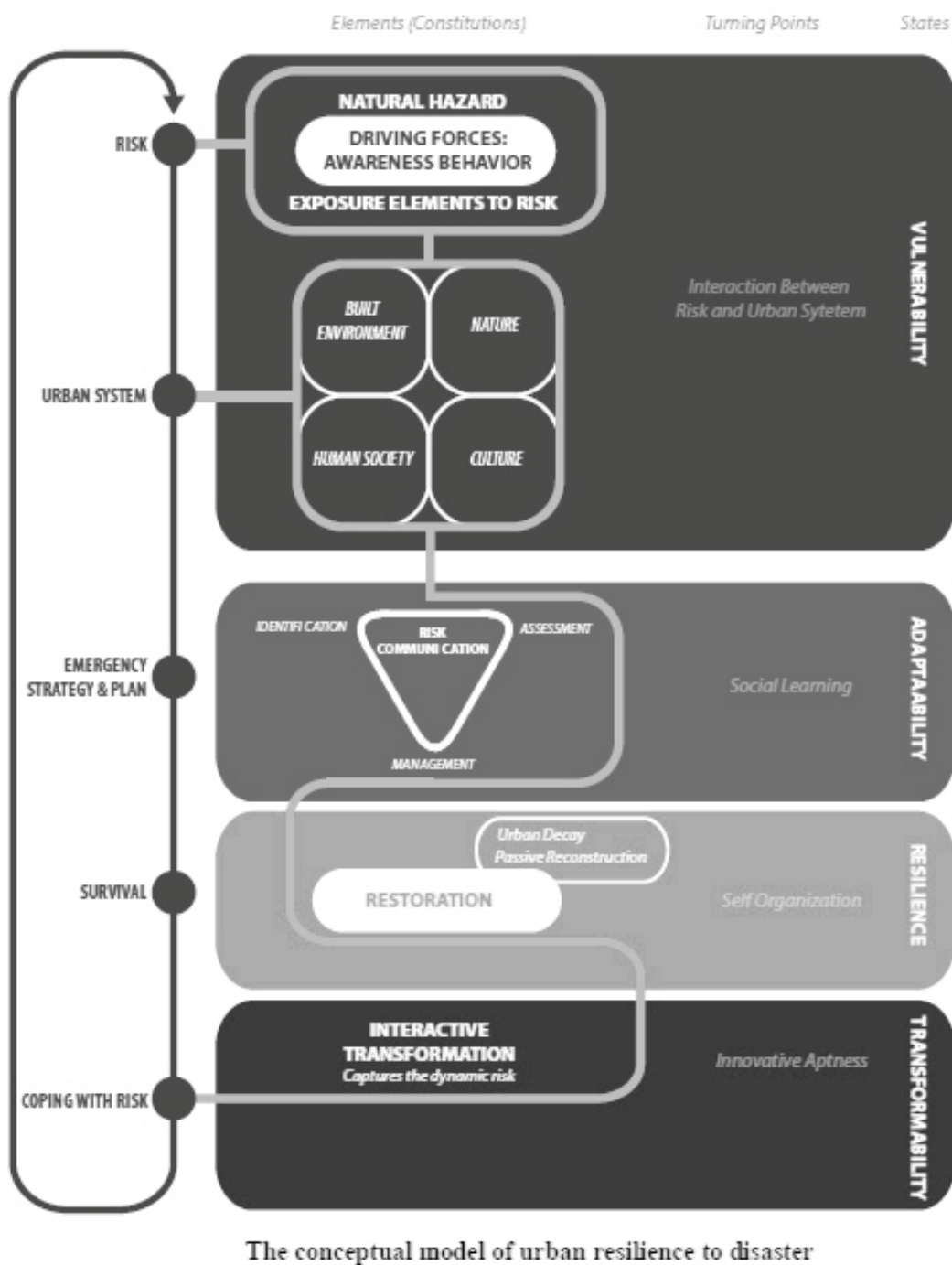


Figure 1: A model of interaction between urban system transformability and risk (Promsaka S. and Rizzi P., 2015)

- This susceptibility is an outcome of the interaction among natural hazards, exposure elements, and exogenous drivers, which contributes to human pressures experienced as vulnerability and *sensitivity* to the disaster impact.
- The disaster sensitivity of the system can be mitigated. The structure that is able to absorb impacts of hazard events will enable the urban system to re-generate resources to maintain its infrastructure as well as to reserve standard livelihood of its residents (towards adaptive capacities of each individual system in the changed structure)
- After a disaster, the resilience depends on how quick and how well the urban system recovers from the hazard events. In this case, social learning processes become a crucial key in strengthening rapid recovery and enabling desirable adaptive capacities (towards development of self-organization processes).(Rizzi, Denti, Marcia, Promsaka, 2016)

2.1 The spatial planning for disaster resilience

In this study, the need of enhancing institutional capabilities to self-organize and create innovative urban planning measures is highlighted. To enhance those capabilities, a process of social learning can be conducted in a way that supports the integration between disaster mitigation measures and spatial policy formulation and implementation. This integration is, in short, named “spatial planning for disaster resilience”. The spatial planning for disaster resilience addresses three crucial characteristics of resilient systems:

- 1) stability and the transformability of physical infrastructure;
- 2) institutional capabilities to self-organize and to bounce back;
- 3) social learning capabilities to create adaptive measures for coping with risk.

Addressing disaster resilience having considered these three abovementioned characteristics in spatial planning provides an alternative to frame problems in order to respond to uncertainty of disaster risk and vulnerability of urban fabrics.

Urban resilience to disasters is a board concept, covering a wide range of elements. For this study, the concept of spatial planning for disaster resilience focuses mainly on the essence of social learning and self-organization, which constitute the evolving institutional resilience of spatial planning authorities. However, the urban resilience to disasters consists of both physical infrastructure and social structures.

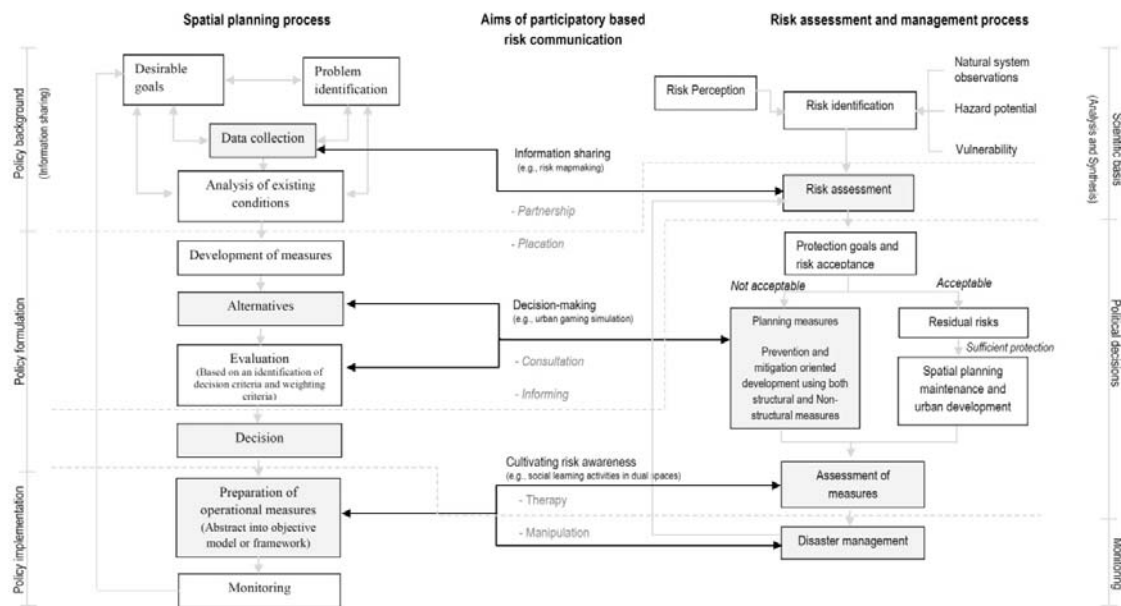


Figure 6-10: A model of spatial planning for tsunami resilience (the integration of risk management in spatial planning)

Note: Sherry Arnstein's 1969 ladder of citizen participation are adapted in this mode

Figure 2: Integration of spatial planning, risk mangement and participatory planning (Promsaka, S. Rizzi P., 2016)

Therefore, the further study on urban resilience should investigate the robustness of physical infrastructure and the transformability of spaces, which can increase comprehensiveness of research.

3. Italy is a seismic country but with short memory.

One of the most challenging effects of the last swarm of shakes between 2016 and 2017 in central Italy unveiled again the weakness and sensitivity of communities and territories to the unexpectedly short frequency of earthquakes. People suddenly realized that it is not "one time in one's life" event but "a series of events more or less dreadful". This shift is important to frame further policies for the entire country with a concern for different hazards (keeping in mind it's a multi-hazard country). However it's common to think that tsunami doesn't affect Italy, a 2006 earthquake (M5) with the epicentre close to Stromboli, which luckily did not cause victims or severe damages, caused a small tsunami. In Italy, tsunami has but low probability, however it's better to keep in mind that "low" differs from "none".

If we think of Campania, Vesuvius eruption is what we'll have in mind, but the most recent event that occurred in Ischia on 21 august 2017 was an earthquake. It was a result of both the activity of the volcano and the peculiarity of the geology of the island. Along with, the fragility of the urbanized area: poor quality of its built environment and controversial localisations for new investments, the earthquake left 2 dead, 52 injured and 1500 homeless. When Ischia was destroyed back in 1883, the number of victims was 2.300 in a population of 4.000. It was reconstructed: does it mean it was resilient?

Resilience is a result of how systems cope with the “day after” but it cannot be achieved if we do not think about the innovation stimulated and/or introduced, level of participation, and cooperation among different scale of planning and decision making policies and, last but not least, impossible without setting the state of art at the moment of the dramatic event. A brief overview of general data and history of the most severe Italian earthquake could offer a key.

3.1 Overview of the last most severe earthquakes in Italy

In the second millennium the Central Mediterranean area suffered of 1300 severe earthquakes. 500 of them occurred in Italy: more than 30 between 1900 and 2017, 8 of which between 1968 and 2017. Analysing the cases we prefer to use the term “process/project” rather than the one of “model” as often can be found in literature (for instance “Friuli or Emilia or Abruzzo Model”).

Place	Belice	Friuli	Irpinia	Umbria/Marche	Abruzzo	Emilia	Center Italy
Date	1968	06.05.1976 11.09.1976 15.09.1976	23.11.1980	23.09.1997	2009	20.05.2012 27.05.2012	24.08.2016 30.10.2016 18.01.2017
Magnitudo	6.1	6.5 5.9 6.0	6.9	6	6.3	5.9 5.8	6.0 Amatrice (RI) 6.5 Norcia (PG) 5.5 Capitignano (AQ)
Homeless*	57.000	80.000	280.000	22.000	67.500	41.000	17.000
Buildings damaged/Da destroyed/De Da+De	9.000 De	31.000 Da+De	75.000 De 275.000 Da	20.000 Da+De	35.736 Da+De	7.700 De	21.000 Da+De
Affected Population	1.300.000	500.000	6.000.000	165.000	144.415	552.312	25.000
Victims	352 dead 576 injured	993 dead 2.400 injured	2.914 dead 8.848 injured	11 dead 100 injured	309 dead 1.500 injured	29 dead	298 dead / 2016 34 dead / 2017
Affected area	5.500 km2	5.000 km2	5.000 km2	strip of 50 km between the two regions	2.375km2	2.700 km2	1.728 km2
Industry damaged/Da destroyed/De		450 (50%) severe Da+De	1.186 business Da+De	2.000 business/Da 1277 supported		606 industries 469 service Da+De	190 industries 372 building 1.356 service Da+De
Agriculture	90% severely damaged or destroyed	20.000 animal died	no record	1.194 damaged 902 now in function		1.143 940 supported	1.894

by Paola Rizzi, Sources: ISTAT, INGV, DCP, Centro Studi CNI su dati Ufficio Studi Camera dei Deputati, Regione Emilia Romagna, Commissario delegato per la ricostruzione Presidente della Regione Abruzzo

The case studies were selected as representative for the evolution of the approach of institutions dealing with risk and disasters.

As pointed out there are no models that could be applied top down to all situations and cases and not only for the different effects of the earthquake related to magnitude, casualties, damages, losses etc. (c.f. a short resume of the result and process of reconstruction in the mentioned cases below).

Place	Belice	Friuli	Irpinia	Umbria / Marche	Abruzzo	Emilia	Center Italy
Investments Mln €	9.179	18.540	52.026	13.463	13.700	13.300	_____
Site of reconstruction	relocated	in situ	mixed	in situ	mixed	in situ	mixed
Period of reconstruction	1968-2028	1976-2006	1980-2023	1997-2024	2009-2029	2012-	2016-
State of reconstruction	on-going	ended in 1986	on-going	ended in 2004	on-going	on-going	on-going
Participation Y/N	_____	Yes no structured / spontaneous	_____	_____	No Movements / spontaneous	Yes regional law	Not yet
Governance of reconstruction	state	multi-level	state	multi-level	state	multi-level	state
Regulation/law (number)[1]	27	7	24	16	224	4	17 (on-going)
Regular intervention tool[1]	_____	_____	_____	PIAT / Integrated Plan of Development of Affected Areas	_____	MUDE / General Digital Model for Buildings	MUDE / General Digital Model for Buildings
Special intervention tool[1]	_____	AdP / Program Agreements	_____	_____	Reconstruction / Plan AdP / Program Agreements	AdP / Program Agreements	_____

by Paola Rizzi, sources: ISTAT, INGV, DCP, Centro Studi CNI su dati Ufficio Studi Camera dei Deputati, Regione Emilia Romagna, Commissario delegato per la ricostruzione Presidente della Regione Abruzzo

[1] data analysed by Luana Di Lodovico

PIAT Piano Integrato di sviluppo delle aree maggiormente colpite dal terremoto

MUDE Modello Unico Digitale per l'Edilizia

Accordi di programma

Multilevel: State, Region, Province, Municipality...

The dynamics of the reconstruction is a timeline where, with all the constrains of political situation, economical trends, social challenges and incidences of corruption as well as long hands of organized crime, some key aspects, approaches and issues are included and developed: the site and temporary/permanent and/or physical/geographical location; the future perspective of communities; prevention, emergency and reconstruction management, the parallel paths of policies and urban planning, the future of Italian landscape (Tacconi, 2016), and, last but not least, the total cost of earthquakes.

1_ physical/geographical and temporary/permanent is the issue of "reconstruction: where and how?". The answer is multi-faceted: where it was as it was, where it was but new, new and in a different place.

A_ Where it was as it was. This is the approach of reconstruction after disaster in Friuli, Umbria and Marche, Emilia. It maintains the identity and sense of place but it's difficult to follow: the former built environment and/or construction technology and material do not match the new building code, the housing standards is poor according to the current standards of comfort, it requires an ad hoc process that is difficult to standardize. The most well known example is Friuli: a long process executed site by site and case by case, based on damages and characteristics of a territory for which technicians decided where to build, according what typology and using what type of materials. The success of the process was related to the high level of awareness and involvement of population.

B_ Where it was as a new town/new town re-located (1) the reconstruction "ex novo" applies for economically depressed or environmentally at risk areas. It is usually unsuccessful unless followed by adequate political actions in the conducive circumstances, as in the case of Gibellina. The most famous examples are the 33 cities built or re-built after the earthquake of 1783 in Calabria and Campania. The king Ferdinand IV took the chance to re-shape the form and functions of the destroyed cities. Most recent example is the "New Towns" built as temporary houses after 2009 earthquake. In the first case the new town is not necessarily an engine to develop a depressed area, in the latter, the new towns are not temporary and will be used once people will go back to their restored homes. Still some unanswered questions rise, though: ownership, management and maintenance or dismantle of abovementioned houses.

2_ The future perspective of communities: decision of "where and how" to reconstruct is always linked with the society, economy, history, demography and culture of the people and communities living in that area. The previous economical trends influence the future development: in Friuli but also in Umbria and Marche after 1997 earthquake small centres in the mountains which already suffered for a depopulation after reconstruction were left and all the small traditional, agricultural, family-owned commercial and handicraft enterprises disappeared.

3_ Prevention, emergency and reconstruction management: disaster events are often if not always followed by an evolution of protocols, codes and procedures. In Italy there were at least some turning points after Irpinia (1980) that followed Friuli's event: the Civil Protection was created and developed, but at the same time a comparison between the two cases shows that meanwhile Friuli was and still is the only one case of a complete reconstruction, Irpinia is the still the most disastrous one. As for the prevention and its management, it was not after the Puglia-Molise (2)event had occurred that new approach, criteria and method for risk mapping and evaluation were created. The event also showed the weakness of school and educational infrastructure and a new set of norms about retrofitting and construction of new school buildings was issued.

4_ Policies and planning: when a disaster hits a place, for a city or a country it's not only a problem of destruction, but also a problem of disruption of the flows of decisions, issues, previous plans, visions etc. These are slow process and it requires time to apply them. The first concern is the urgent need of quick recovery and reconstruction. And here the crucial issue lies: the continuity. The reconstruction's main criteria are: be quick, improve safety, comfort and quality of life, increase services and infrastructure looking for a positive trend for the economy. The issue is: what about a previous state of a territory that is poor, in decay and moreover without or with bad plans and strategic vision of the future evolution?

4. First conclusions

The history has shown that the cases where the reconstruction was successful are the cases where an equilibrium was created between the spatial planning and the risk assessment and management processes: in Friuli, Umbria / Marche and Emilia cases. The multilevel

governance decreased the number of laws and regulations. However, it requires negotiations and co-ordination processes in which many and often very heterogeneous parties are involved. It increases the time needed to start the reconstruction but, once started, it accelerates the process. Participatory processes allow to avoid conflicts and keep the solutions realistic while decisions made and executed at the central level, however fast and, as a result, apparently efficient, in the long term perspective lead to conflicts as well as under- and over-estimations. In L'Aquila, for instance, one of the regulation introduced the concept of *unità equivalente*: the owners of the houses destroyed in the 2009 earthquake ceded their properties to the local authorities receiving a generous equivalent in order to purchase a new estate. The aim of the concept worth 170,000,000 euro was to allow the authorities to administer and control properly the process of reconstruction as formal owner. It was presupposed that people will re-buy their homes once reconstructed, but only 50% of the 600 families, that received the subsidies, did. Others bought houses in other parts of the region or as far as Rome, Cagliari, or Courmayeur. The only lesson the central government learned from this resulted in abolishing the norm in the new tranche of financial aid for the central Italy.

4.1 About the Central Italy earthquake

It's important to underline some issues related to demography, society, geography and economy of the Central Italy struck by earthquake in 2016-17.

According to the data offer by ISTAT (2016) (3), an area divided into three regions (Abruzzo, Lazio and Umbria) is ageing: 28,3% of population is over 65 years old (+6,3 % of national average) and 10,2 % under 14 (-3.5 % of national average) and the average income pro capita is 78% of the national average and is an economy based on agriculture (7 farms/100 inhabitants vs 2,7 farms/100 inhabitants of national average), the 50% of the area is included in Natural Protected Zone and it is low density (around 14 ab/km²). Last but not least, the buildings are dated prior to 1971, before the new building code was applied. The approach is to rely on the central driven but the history has shown on how delicate is to balance the top down and bottom up approaches.

Emilia is showing how to govern the reconstruction dealing with the process: engaging community in the disaster recovery process mutually build disaster recovery plan.

Nowadays, a sort of a Meta-Plan (Strategic Agenda) that includes spatial planning process (multilevel), multidisciplinary approach-to control science, political decisions and monitoring the risk assessment and management process and participatory processes (see Fig 2) is necessary.

5. Is still an on-going process...

The effects of extreme natural phenomena are indeed amplified by political and planning choices that drove to high land usage and building in vulnerable and risk areas, to fast progressive degradation of buildings ,urban and territorial infrastructure, to disrupting progressively the urban functions without a strategic vision of the city. Now, it's fundamental to work out a system/frame which includes and updates all the local skills and data, often already set by several Regions, but with the specific view on disaster mitigation and sustainable development. This is the first step: to create a digital network platform. It will be accessible for administrations, institutions and professionals and it will have a double goal: to create a dynamic knowledge of the territory and help and support decision makers in generate efficient policies and plans which support a sustainable development and increase resilience of the territories.

This M-Plan (Strategic Agenda) supports the design and updating of General City Plan. The Plan will frame the main point of the development model of the territories trough the conservation/promotion of local identity and feature, the safeguard of the area, the control of land consumption, increasing the criteria standards of services and environment, and last but not least to create a proper relationship among energy-environment-landscape.

Re-define or define a model of evolution and development, which is going to shift the vulnerability and fragility of these territories to resilience. The reconstruction is not only a mere process of re-building but its aim is to recreate and improve the chance for the future evolution of a city, a territory and its inhabitants. To enhance the development we need to remove all the obstacles related to the poor state of anthropic (houses, infrastructures, monuments, heritages, etc.) landscape and natural resources. These are barriers caused by lack of knowledge of the nature and state of territory and lack of prevention of disaster, of state of neglect and decay. There is a need to overcome the reconstruction/restoration plan as synonymous of "what it was as it was" but through the M-Plan enhance a new perspective of development and safeguard of the city. The M-Plan is a tool that in one hand enables the planners to state properly the problems and, on the other hand, to tune, regardless the participatory processes, the map of shared goals (strategy agenda), the topic of urban safety (including in the system the mandate of Civil protection Plan, of Sismic MicroZoning, of CLE etc) and the development model

- (1) It is a principle that it must be followed for the high risk still in the place (Portis after Friuli earthquake in 1976) or it's a decision taken to stimulate a new re-birth (after 1783 earthquake in Calabria), or an ambiguous action to recover quickly (New Towns after Abruzzo earthquake in 2009).
- (2) Puglia-Molise is the case not included in this study: it was an M 5.7 earthquake which caused 28 victims for the collapse of a school. All the area was considered the low risk area. After the event a new classification of vulnerability to earthquake was studied and applied.
- (3) Focus statistiche, *Caratteristiche dei territori colpiti dal sisma del 24 agosto 2016*, ISTAT www.istat.it

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