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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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Planning to prevent disasters

A short reflection on the correlation between ordinary planning and risk mitigation

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Abstract

The evolution of cities, whose pattern is all but regular, is sometimes marked by rare events that may disrupt the normal development. Throughout history, cities grow and shrink, flourish and perish, in a slow and somehow predictable way, but sometimes they suffer sudden and unexpected changes. Those breakages that profoundly modify their urban schemes and land-uses, their identity and their economic and social activities, transform them into entirely new cities or radically convert large portion of space.

Whatever the outcome of a disaster could be, although it may result in a pattern of positive development, we must prevent the loss of human lives, the suffering, the loss and damages that accompanies every catastrophe. The main task of human action must therefore be risk mitigation, bearing in mind that risk is always present and the resources to mitigate it are often scarce.

Without going into the detail of any particular event and with methodological intent, the paper will try to investigate how we can better understand risk and how planning may influence the mitigation of risk.

Keywords

Safety; Security; Planning in hazardous areas.

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1. Introduction

The evolution of cities, whose pattern is all but regular, is sometimes marked by rare events that may disrupt the normal development. Throughout history, cities grow and shrink, flourish and perish, in a slow and somehow predictable way, but sometimes they suffer sudden and unexpected changes. Those breakages that profoundly modify their urban schemes and land-uses, their identity and their economic and social activities, transform them into entirely new cities or radically convert large portion of space.

Earthquakes, volcanic eruptions, large landslides, forest fires, technological disasters and major industrial accidents, biological and chemical contamination and even terrorist acts are those catastrophes that may change the evolution patterns of urban settlements.

Disasters of similar intensity may have profoundly different impact on towns and cities. In some cases, the breakage is such that the places are rendered forever uninhabitable. A couple of examples, in very different times and conditions: Noto, in the southern-eastern Sicily, has been abandoned after the disruptive earthquake of 1693 and Prípiat has become an inanimate place after the nuclear disaster at Chernobyl in 1986 (Fig.1).

Noto, was in a geographical and morphological context of an hilly place that is (now) well known for amplificating seismic waves. Moreover, the urban design made of curved narrow streets is particularly vulnerable, as the buildings were non-seismic resistant.

The case of the radioactive fallout that makes places inhospitable has not been considered, due to the underestimation of the nuclear hazard and the inadequate security measures in Ukraine.

Noto (Italy), in the southern-eastern Sicily, has been abandoned after the disruptive earthquake of 1693.

Prípiat (Ukraine), was evacuated after the Chernobyl nuclear accident in 1986, when it had nearly 50,000 inhabitants.

Fig.1 The abandonment and the reconstruction can lead to completely different urban organisms

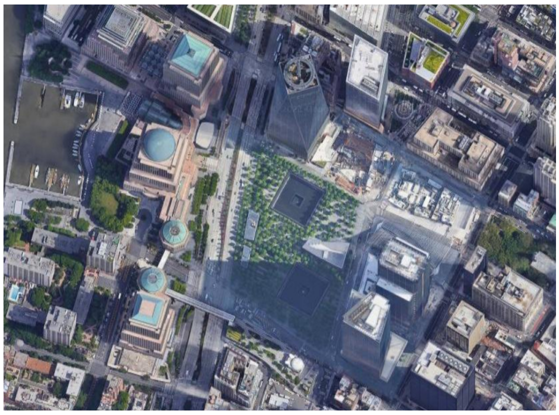
As a consequence of such a vast and profound destruction, those places have been abandoned, mainly because the on-site recovery was inconvenient or simply impossible.

It happened several times in history, to entire urban settlements, or part of them. The wound being sometimes so profound that the site affected by the disaster has been intentionally reported, becoming a memorial. That was the case after two completely different events, reason for as many great monuments: the expanse of concrete of Gibellina in Sicily and the Ground Zero memorial in New York.

In the first example, a new *filling* in the emptiness of nature to keep the memory of the previous dwelling. The second example: an unusual *empty space* in Manhattan's urban density, to underline the extent of the shock suffered and to respect the memory of the victims (see Fig.2).

One last introductive remark: many disasters have triggered processes of rebirth and new economic development. The crisis can bring progress, as in the crisis we learn from our mistakes and some great strategy may arise.

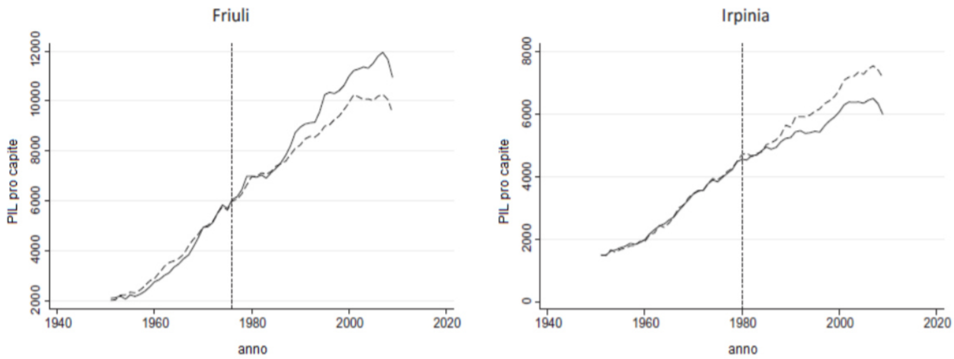
Gibellina was destroyed by an earthquake on January 15th, 1968. The *Cretto* from Alberto Burri recreates the place where the village stood.



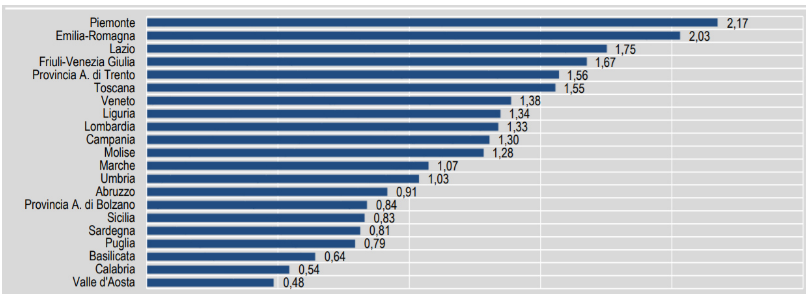
Ground Zero in downtown Manhattan: a terrorist attack destroyed the twin towers on September 11th, 2001

Fig.2 The expanse of concrete of Gibellina in Sicily and the Ground Zero memorial in New York

Noto (the "new" Noto) is one of the most fascinating dazzling Italian Baroque city, as the relocation was the opportunity for complete reconstruction. Regions as well may change their development patterns when strucked by disasters. In Italy, the emblematic case of Region Friuli certainly deserves attention. The buildings in the region have not only be rebuilt "as" and "where" they used to be, but the entire territory has also embarked on a new path of economic development, which has led it – among other things – to be today the fourth Italian region as of the percentage of R&D expenditure on GDP (see Fig.3).



Two Italian cases: Friuli (north of Italy) had a better development pattern after the earthquake of 1976, whereas Irpinia (south of Italy) had a worse one after the earthquake of 1980. (*The dot line shows the normal evolution of per-capita GDP, i.e. without the seismic event.* Source: Barone & Mocetti, 2014)



Friuli is the fourth region as of private R&D expenditure out of GDP (Source: ISTAT, 2018)

Fig.3 The resilience at work: how regions can react to catastrophes. Long term economic trends after earthquakes.

Whatever the outcome of a disaster could be, although it may result in a pattern of positive development, we must prevent the loss of human lives, the suffering, the loss and damages that accompanies every catastrophe. The main task of human action must therefore be risk mitigation, bearing in mind that risk is always present and the resources to mitigate it are often scarce.

Without going into the detail of any particular event and with methodological intent, the paper will try to investigate how we can better understand risk and how planning may influence the mitigation of risk.

2. Risk and the classification of disasters

What we call disaster, is a rare event that may cause harm and damages. Rare, as the frequency is low when compared to the normal functioning of a system. For example, an earthquake is extremely rare compared to the life of an urban settlement, as it may happen every few centuries, while a plane crash is rare if compared to the volume of traffic and the number of circulating aircrafts, even if several accidents may occur every year. Generally speaking, there are two ways of protecting against disasters. Prevention, so to reduce the probability of occurrence, the magnitude (when possible) and/or the amount of damages. Crisis intervention and recovery, also aimed to reduce damages, but with less efficacy and permanent losses (Røstum et al., 2008).
Rare events are most often concentrated in time and space, but their preparation can last significantly different and the area affected covers a wide range of possibilities.
Using the same examples, the concentration of forces that will be suddenly released in a seismic event will take decades or centuries to reach the critical point. As a consequence, the time to implement a safety plan can be long enough. Due to the high costs of prevention, the limited resources must be concentrated where the most dangerous event are expected. That's why the seismic zoning is the first and most important action to implement. A plane crash is a sudden break in the system, but scattered in time and space, as due to factors that can be instantaneous, such a malfunctioning or a distraction. Time and money must be devoted to design and implement a safety plan of the entire transportation system, with a particular attention to active safety measures. In order to mitigate risk, the well-known definition as a combination of three main elements is crucial. Risk is a non-linear function of hazard, vulnerability and exposure (Varnes, 1984). Through the management of those three fundamental components, most phenomena can be described and understood and the countermeasures implemented.
The word risk is commonly associated with concepts like uncertainty and loss or damage: the emphasis is more on the aspect of uncertainty, when the unpredictability of the event is pointed out; while it is more on the aspect of entity of damage, when the severity of the event is underlined.
Hazard (H), in the sense of possibility of damage (Volta, 1981), joins the two concepts in the same definition. The measurement of damage is substituted by the monitoring of two variables:

- vulnerability (V), or the propensity to damage as a consequence of a given event;
- exposure (E), or the quantity and value of goods (human beings and material goods) that are present in the area effected by the event.

So risk can be defined through the following function:

$$R = f\,[\,H\,(I);\ V\,(I,T);\ E\,(T)] \tag{1}$$

R = risk
I = intensity of the event;
T = typology of element potentially subject to disaster effects (population, goods, infrastructures, etc.);
H = f (I) = hazard, or the probability that a phenomenon of a fixed intensity (I) will occur in a defined period of time and in a given area;
V = f (I, T) = vulnerability, or the propensity to be damaged as a consequence of a fixed event (I) and in function of the typology of elements subject to hazard (T);
E = f (T) = quantity and value of the elements (T) subject to risk.

Hazard

The hazard can be defined by the intensity of the event, its link to the return time and the local conditions (called local hazard). The energy released by a seismic event, related to a given frequency; the volume of a landslide; the dangerous road conditions in the transport system can be assessed and mapped. Hazards can be concentrated (as in the technological disasters) or spread in wide areas (as in the case of meteorological phenomena).

Vulnerability

Different reactions to a given hazard reflect the conditions of the exposed elements (people and goods), but can be highly influenced by prediction, preventive measures, and emergency measures (the latter only when damages are reversible). The two main concepts of prediction and prevention are so introduced:

- a prediction oriented policy concentrates the efforts on studying predictive phenomena, in order to try to know before the time when the event will occur and its features;
- a prevention oriented policy, on the other side, try to plan the new pattern of the system and to prepare the targets exposed, in order to reduce vulnerability and then the risk itself.

Exposure

The third variable of risk function is the exposure: the risk increases when the quantity and value of targets increase. The maximum of exposure is determined by the presence of human beings, but also material goods are taken into account, such as factories, buildings, schools, hospitals, transportation and technological infrastructures, environmental goods, etc.

Urban habitat and its increasing complexity is the place chiefly exposed to risk, as it contains all of these functions. Nevertheless, the question of efficient exposure indicators remain prominent. The socio-economic level of population, the destination of buildings and the intensity of man presence are often chosen as possible indicators.

Preparedness can be better understood when the three components are isolated and the disasters are clustered in order to focus on the control of one or more components.

A proposal of disaster classification is shown in table 1 (Tira, 1997), where the events have been organised into three different categories.

- Physical events, where the cause is structurally natural (but the damage is not) and humans cannot determine the occurrence; in those cases, prevention activities must be concentrated on the reduction of vulnerability and exposure. Those activities are classified as passive ones, since no chance is given to reduce the magnitude of the event. The best examples are the seismic events: against them, passive safety measures are the building codes, as well as the rules for a seismic resistant plan (as in the examples illustrated in the next chapters);
- When passive safety is the only possible reaction, the marginal cost of interventions has to be calculated, in order to best locate scarce sconomic resources. The best solutions are those that realise a higher increase of safety with the same amount of money. The severity of building codes for seismic resistant structures is calculated assuming the building will be damaged by the event, but not collapsing, so saving lifes (but accepting damages to the structures and the goods);
- Physical events, where the cause is both natural and anthropic; in those cases, prevention activities must be concentrated on the reduction of vulnerability and exposure, but hazard can be also mitigated at a certain extent, at least by reducing its intensity. A typical example are floods, as a result of heavy rains (natural) and the impermeabilisation of soils (as a result of planning choices). Hydraulic models clearly show that the runoff is accelerated by impermeable soils, so that the river flooding will be more intense and rapid, so reducing also the possibility of application of emergency meaures.

The effect of the land use choice is a long process and the river basin as a whole may be interested. Safety measures can be active, as the revegetation or passive, i.e the strengthening of river embankments.

- Man-made events, where natural features may influence the results in harms and damages, but not the occurrence. The most important prevention activity is the reduction of hazards as depending from voluntary human activities. A typical example is a transportation accident, where the combination of three components influences the probability of resulting in harms and damages: the human behaviour, the technical failure (engine, breaks, etc.), the environment (the road layout, for example). In that case, safety measures can be either active (the intelligent braking systems or the lane control device) and passive, like the airbags.

In other words, we could cluster those disasters by the percentage of naturalness. That percentage is inversely proportional to the degree of voluntariness: the more an event is naturally based, the less it is voluntary, and the other way round. The terrorist acts are the extreme example of voluntary events as they are planned to cause harms and damages.

Also directly proportional to the voluntariness is the area of resentment of the events. Earthquakes are comparatively intense and concentrated (in space and time) when compared to ecological contaminations.

Type	**Origin**	**Disaster**
Seismic phenomena	PHYSICAL	* Earthquakes * Tsunami * Volcanic eruptions
Meteorological phenomena		* Hurricanes * Tornadoes * Severe fog episodes * Drought
Geological phenomena	*INTERMEDIATE*	* Floods * Mud or landslides * Avalanches * Epidemics
Ecological disasters (contamination)		* Forest fires * Chemical * Physical * Bacteriological * Radiological
Means of transportation accidents	MAN-MADE	* By air * By railway * By road * By sea
Technological disasters		* Barrage breakage * Bridge and structural collapses
Major industrial accidents		* Explosions * Fires
Terrorists acts		* Biological and chemical contamination * Mine disasters

Tab.1 A proposal of classification of peacetime disasters (Tira, 1997)

Indeed, any physical event is influenced – to a certain extent - by human actions: for example, the effects of an earthquake are strongly linked to the social organisation, the Institutional framework, etc.). At the same time, the consequences of any man-made disaster can be worsened by natural conditions: for example, the effects of traffic accident are highly influenced by the weather conditions.

In the English wording there are some differences between the words "safety" and "security". The term "safety" is used for protection against unintended incidents (natural or intermediate), while the word "security" is often used to describe the reaction against deliberate incidents (man-made).

We will define as "unsafe" that place that is prone to physical hazards, those due to natural characters of human habitat (such as earthquakes, hurricanes, volcanic eruptions). An "unsecure" place is that subject to the man-made hazards, caused by anthropic modifications of the environment (i.e. technological hazards, such as major industrial accidents or oil spills; environmental hazards, such as chemical contamination or water pollution; traffic conflicts and accidents; riots and terrorist acts).

3. Planning as an opportunity for rebirth

The introduction outlined some extreme consequences of disasters. Those are situations that have led to new localisation choices, either total or partial.
Dealing with cities, however, the most interesting examples and those where recovering *in situ* replaced the living conditions as similar as possible to those before the disastrous event. The competitiveness and vastness of human settlements is such that it would be vain to think of new locations to escape the threats arising from natural or anthropic phenomena. It is therefore in the reconstruction that the most current challenges and problems are found and where the circularity of figure 5 finds its most challenging expression.
Many examples of *in situ* reconstruction of cities (generally larger and more complex) can be found in history, recovered and adapted to the new disaster protection needs that had affected them. For example, the reconstruction plan of Catania after the earthquake of 1693 and the new Lisbon after the earthquake of 1755 (Fig.4).

Catania, plan from A. Vacca (1960). The radically new town scheme is evident overall in the road network

The new plan of Lisbon according to Eugénio dos Santos and Carvalho, and Carlos Mardel (Source: plan of the town by J. Pinto Ribeiro, Gabinete de Estudos Olisiponenses, Lisbon)

Fig.4 The resilience at work: how cities can react to catastrophes

Catania has been re-planned in order to resist better to new possible events. The dimension of the town was too big to be entirely moved in another place, so the project was entrusted to a team of experts, formed by well-known architects such as Sebastiano Ittar, Stefano Battaglia and Giovanni Battista Vaccarini. The city was redesigned according to practical logics and ideals of illuminism, typical of the European context of the time. That is maybe one of the first examples of seismic resistant plan (together with Lisbon after the earthquake of 1755). The project involved a new road layout of the city, much more schematic and practical, accompanied by the widening of the streets and the creation of open spaces that are still signalled today as safe recovery places in case of emergency. The reconstruction has become a symbol of economic recovery in the modern history of Sicily as after the first period of emergency, the extensive construction activity carried out in the affected area reactivated its entire production cycle (L. Dufour and H. Raymond, 1994).
Lisbon was rebuilt by Sebastião José de Carvalho and Mello, Marquis of Pombal. Between 1756 and 1777, Pombal promoted the reconstruction of half the city. He completed his work by erecting, instead of one of the cornerstones of eighteenth-century urban planning, "the royal square", the Piazza del Commercio, whose name explains what was the result of the reconstruction of one of the capitals of Europe. The reconstruction was carried out on the basis of the proposals of an 80-year-old military engineer, Manuel de Maia, who followed three different directions, the same that in the face of every catastrophe urban planners are obliged to

propose: the reconstruction of the city as it was; a radical reform that would allow it to be modernised; the construction of a new capital. The choice was to radically renovate the city by reforming its ancient plant, as the logic and intelligence of an administrator of Pombal's stature and the interests he represented imposed (Dal Co, 2012).

Preparedness is the only wise approach, and planning is a typical preventive action.

Describing the space development when facing a disaster as a circle, crisis intervention has to be seen only as the pre-condition for the correct prevention and preparedness activities. The chain (Smith, 1998) consists of the following stages which together make-up the so called disaster (or risk) management cycle:

- pre-disaster or preventive planning covering activities which range from the construction of defensive engineering works to land use planning and elaboration of evacuation plans;
- preparedness reflecting alertness immediately before the onset of a hazard, when feasible;
- response referring to reaction activities immediately before and after and (emergency) relief operations;
- recovery and reconstruction, concerning the long-term activities destined to return an area to "normality" after severe devastation.

The so-called cycle risk management approach (Swiss Federal Office for Civil Protection, 2008; Fig.5) has been quoted several times as a clear taxonomy for all step of risk management (see among others: Røstum et al., 2008).

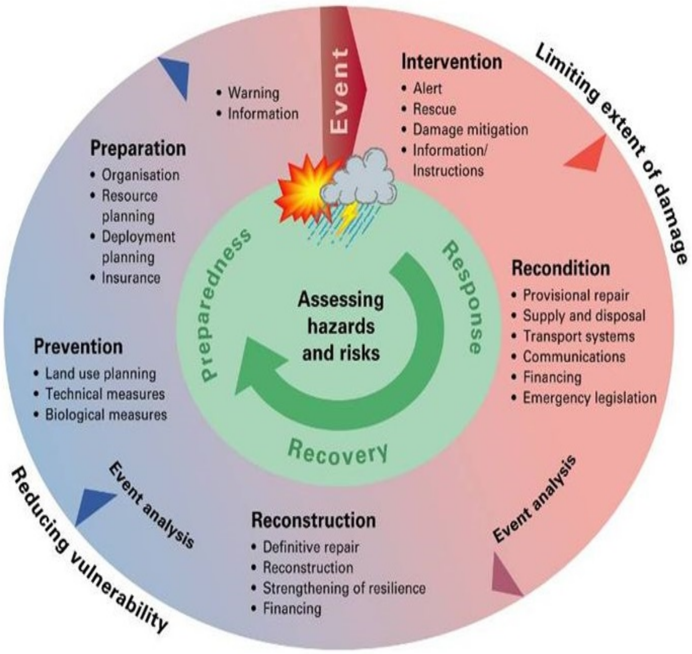


Fig.5 Cycle risk management (Source: Swiss Federal Office for Civil Protection, 2008)

Land use planning is in the prevention part of the circle, and the sector of vulnerability reduction. The value of danger is provided either by specific studies or regulations, whereas the values of vulnerability and exposure are to be defined, considering the complexity of urban systems.

Exposure depends on the presence of goods and people in the hazardous area, and can be assessed as the presence of average residents per area or the destination of buildings.

Spatial planning of risk areas must therefore take into account that prevention must be entrusted mainly to ordinary rather than non-extraordinary instruments.

The reliability, safety and security of urban systems must be an inalienable objective of ordinary planning activity. The duty of sound planning is to provide the direction for growth that guarantees the maintenance of a level of functionality in case of crisis, the so-called resilience, whereas the duty of correct emergency planning

is to ensure, as quickly as possible, the restoration of the (previous) conditions essential to urban functioning. Nevertheless, any emergency action can be a first step towards the following preventive activity!
Modern planning legislation contains at least a couple of very relevant contributes to mitigate risk through the planning process: the geological survey, as a compulsory content to add at the many prescribed for the design of urban schemes in risk sites and the strategic environmental assessment (SEA), as a compulsory evalutation procedure, introduced by the EU Directive 2001/42.
The geological survey is relevant to reduce the impact of land government with regards to the geomorphological features and the previously defined natural and intermediate disasters (see Tab.1).
The SEA is a broader environmental evaluation of the effects of a plan, assessing the effects on the full environmental matrix.
Both geological survey and SEA present weak point. The geological survey influences planning costs, being a complex and long procedure. So, it is often reduced to some parts of the plan, where an a priori development strategy is going to be implemented.
The SEA, also costly and long, is often reduced to a qualitative analysis of the major impacts, often neglecting the probability of occurrence of rare events, changing the scenario.
Planning frameworks are quite appropriate, practice is far from being, also still mainly influenced by the socioeconomics demands arising from the citizens.

4. The socially acceptable risk level

Planning processes are extensively in-depth processes, which deserve to be examined more widely. The two reconstructions of Catania and Lisbon are due to totalitarian regimes, which have more easily in history been able to reorganize urban spaces quickly, but to the detriment of the indispensable democratic processes that no one would give up anymore, not even in the face of greater security (what about the debate about the restrictive measures imposed by the COVID-19 pandemic?).
The increased need for transparency of programming and planning choices, due to the presence of various and clashing goals, determines the problem of allocating the public finite resources.
While risk is measurable, the reaction to threats can be very different according to personal culture, age, preparedness, and health conditions.
For example, the youngers are more unconscious of the effects of hazardous activities and situations, whereas the elderly may have a distorted perception of the most dangerous activities. For example, old population living in wealthy European urban environment is much more scared by personal attacks, than from car accidents. The evidence shows that traffic casualties are more and more severe than muggings.
Worth mentioning also a couple of other elements influencing risk perception.
An overestimation is very common when the target exposed feels like being without control on the situation. In the field of transportation, that clearly explains how air transportation is often perceived as a more dangerous means of transportation when compared to car.
Secondly, an underestimation of the consequences of disasters is recorded when the events are scattered (diffuse) in time and space. Again, that is a reason why road casualties (that are many more) have a smaller impact on public opinion when compared to the casualties resulting from a plane crash (rare but concentrated in time and space).
Conflicts and then risks are an unavoidable dimension of urban life.
As a consequence, risk management policies and the planning choices call for a coherent determination of the acceptable level of risk, both when compared to benefits coming from human activities and to the available resources to mitigate risks themselves.
The problem of making explicit the implicit level of socially acceptable risk has been addressed extensively in the literature. With reference to Starr (1969), we may quote at least three relevant alternative approaches.

a) Risk balance: the approach assumes that a level of risk higher than zero is socially acceptable and seeks to determine this by comparison with known cases, such as risks arising from activities similar to those charged. The evidence shows that people accepts voluntary risks much more than those deriving from involuntary events;
b) Cost-effectiveness balance: this approach measures the reduction of the risk obtained for each euro spent on security measures. The acceptable level of risk is that a further increase in expenditure generates such a small reduction in risk that it is now considered insignificant. In this way, different types of hazards can be compared and, once the resources for risk reduction have been allocated, it may be decided to invest them in those that have a better cost-effectiveness ratio. Please note, however, that not all security policies have a "measurable" cost;
c) Cost-benefit balance: the approach assumes that a level of risk greater than zero is socially acceptable if other objectives are to be achieved. The acceptable level is determined by balancing the benefits of an activity with the risks it entails. For example, balancing the localised benefits (less distance, lower transport costs) of some production facilities in hazardous areas: the greater the difference between the benefits of planting in such areas and safer but more disadvantageous areas, the higher the acceptable level of risk. As a result, plants with the greatest localised constraints, i.e. less transferability, are those with which the highest tolerated level of risk should be associated.

However, accident protection behaviour is markedly different according to the social weight and not just the individual weight attributed to them: in general, there is less attention paid to events that affect them more dispersedly (or at least apparently so) and greater attention to events concentrated in space and time.

This could result from an objective greater difficulty in protecting against the widespread phenomenon, but it follows above all from the different level of acceptability of the risk itself. Proof of this is the fact that even for road accidents, for example, a typical dispersed event, non-random concentrations (the so-called black spots) occur, but awareness of this characteristic of the phenomenon is very little widespread. Only recent acquisitions and specific research highlight the recurrence of road accidents in typical and recognizable urban situations. The level of social acceptability of the risk is a consequence of these brief differences, but at the same time partly determines them in cultural stratification and collective imagination.

5. Some conclusions

In drawing up some attempts at conclusion and, above all, trying to outline some perspective, we may take up a couple of questions: why does town planning, which has so much to say about issues such as emergency planning and risk, fail to play the role it deserves? Is the problem with the "speakers" or the "listeners"?

There are many possible answers.

First of all, the complexity. The ideal, static models that correspond to archetypes with which we try to describe urban realities actually correspond to a schematization of a reality that evolves and transforms according to probabilistic logics.

We know the main events that can occur with reasonable probability, but we are unable to reproduce on paper, except with subsequent scenarios, the outcomes of these events.

In other words, urban planning acts with static planning acts, superimposed on a rapidly changing reality.

A second element is the scarce diffusion of the concept of prevention: it is little understood in Italian society, little practiced in general, and this is reflected in the "listeners", in those who govern at all levels. We live in a "fragile" territory, but at the same time we are used to a generous nature, which has made us forget the need for a balance between anthropic development and environmental protection. Furthermore, we are immersed in a pervasive faith in technology that makes us believe that any human undertaking and any compensatory solution are possible.

The basic reason why prevention is not a common value in Italian society, however, is the lack of attention to the common goods. The awareness of belonging to a *unicum* is much weaker when compared to our interest on private space.

A third level of problem concerns the formation of political consensus. In the process of designing urban plans, the administrations dedicate an infinite amount of time to the evaluation of small interests, often losing sight of the strategic design. With this approach it is practically impossible to prevent risks, as prevention implies the ability of strategic reasoning and a medium-long horizon for choices. Many choices of prevention could be unpopular, they do not pay in the electoral arena, as they may limit private property, in view of the common utility to which it is also called.

A fourth element, which instead concerns the "speakers" and therefore the discipline, is the need to investigate the aspects of the interaction between physical elements and urban structures. Without serious consideration of these matters and design abilities, traditional planning processes are blunt weapons, if not the very cause of the problem that one would like to solve.

In other words, forcing the reasoning a little, we are asked to determine the response spectrum of the territory to external input. This means measuring the contribution and effect of impacting actions on the different components of urban systems and decode the response of each of them to the various inputs (Galderisi, 2020).

So, a change of attitude is needed: to get out of the logic of the emergency, we could say that we should transpose the emergency into the administrative and decision-making processes and raise a civic awareness of the value of the common goods.

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Fig.3: Barone & Mocetti, 2014 and ISTAT, 2018

Fig.5: Swiss Federal Office for Civil Protection, 2008

Author's profile

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