RESILIENCE AND RISK MULTIADAPTATION: A METHOD AND A CASE STUDY (1058)

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Abstract. The term resilience is used in many disciplines due to its adaptability to theories of complexity, including economics, ecology, political science, cognitive science, new technologies and land-use planning. Consequently, Zolli and Healey's (2012) definition of resilience understood as "the ability of a system, company or person to maintain its fundamental purpose and integrity in the face of radically changed circumstances" integrates ecology and sociology and offers an overview of the multidisciplinary nature of the issue.

It is also true that resilient spaces are spaces capable of adapting to change by contributing to their balance. This must be appropriately planned and managed also with the use of indicators capable of measuring the performance of cities. Therefore, the purpose of this study - carried out within the research project PRIN 2020 SUMMA is to define multiresilience and multiadaptation starting from the concept of resilience and adaptation and present the synthesis of a case study carried out with an *ad hoc* method.

Keywords: multiresilience, multiadaptation, multirisk, sustainable urban design

1. Introduction: Complexity of contemporary territories and multiresilience

The complexity of the current territories is due to the increasing circumstance that several crises occur simultaneously causing great difficulties to suitably respond to them.

In fact, resilience often considers the events that cause a crisis in a system to be equal despite having different characteristics. Among these, for example, since there is no definition of how to pursue it, the degree of resilience of communities after a sudden event may not be the same and even within the same community different behaviors may occur.

Considering an evolutionary approach (Bohland, et Al., 2019; Davoudi et Al. 2012), there is no single equilibrium in ecology but there are multiple equilibriums; however, the question to focus on is the type of balance to refer to rather than the causes that could alter it.

A social or cultural crisis must be faced with different approaches than that due to an

environmental catastrophe and, moreover, even the same type of crisis can have different durations of effects with as many variable response times. The multidimensional characteristic of resilience makes the concept of resilience flexible on the one hand and elusive in its entirety and complexity on the other, requiring continuous updates and insights. Current studies are focusing on environmental risks and, more recently, on those due to epidemics such as in the case of Covid-19, allowing the inherent problems to be highlighted more clearly (Vale, Campanella, 2005).

Applying the concept of resilience to socio-environmental systems such as cities means anticipating crises and strengthening cities with proactive solutions that can enhance both public and private places at the same time.

However, preventive resilience requires choices that involve expenditure, investments and also decisions about which people and places are at risk and which should be protected, whether the hazards are man-made, natural or a combination of them. A holistic view of preventive resilience should include consideration of the needs of all stakeholders and the different types of potentially affected locations.

Certain factors and their components are important in determining resilience, including: vulnerability analysis, which has as components uncertainty, informality, demographics and urban distribution of vulnerability; uncertainty-oriented planning, which has adaptation, planning and sustainable form as components; urban governance, which has equity, integration and ecological economy as components; and prevention, which has mitigation, refurbishment and the application of alternative energies as components.

Uncertainty is another important component in the study of resilience because the lack of knowledge about future environmental and other crises makes people and places particularly vulnerable. To mitigate the impacts due to the uncertainty of future events, planning and management of urban and political risks must be taken into account in advance.

Integrating uncertainties within the planning process and improving collaboration between different institutions and organizations, both public and private at all levels, are key components of resilience. Similarly, social diversity must be considered in order to reduce it through a more balanced distribution of resilience resources.

Prevention is assuming an increasingly important role in urban resilience especially if thought of in terms of risk mitigation - which can translate into not only a reduction of greenhouse gas emissions, but also of inequalities and social imbalances in terms of urban decay - and flexibility to concretely face ecological, cultural and economic challenges with specific strategies and policies for the transformation of cities.

Resilient planning should therefore be oriented towards uncertainty and go beyond

traditional approaches, preparing cities for possible changes. Adaptation in this sense is essential to limit the damage of climate change and, more generally, of economic, social and health crises. Planning should include a wider range of conditions and, in particular, develop ex ante and ex post analyzes to adequately adapt to sudden situations.

Another component of uncertainty is the sustainable urban form, which concerns many aspects of resilience: livability, urban health, change, climate, multiculturalism are just some of the elements that influence contemporary public policies and must be taken into consideration for a good form of the city (Lynch, 1984). Urban compactness and contiguity, high-density planning, sustainable transport and equitable access, mixed land uses, diversity of housing and built form, passive solar design, greening in particular cities and the renewal and use with the rehabilitation and re-functionalization of brownfield sites constitute the key evaluation criteria of the sustainability of the urban form (Jabareen, 2013).

In this regard, as Desouza and Flanery (2013) observe, the social sphere is composed of three types of elements, namely people, institutions understood as the set of individuals who converge towards common goals, and activities, understood as functions that people and institutions have in relation to designing, building and using. In this framework, people play the most important role because the other two components are built around them. Furthermore, the physical and social spheres often overlap and many activities within a city arise from the meeting of these two spheres. In public spaces, for example, it is possible to observe interactions between different people, activities (walking), institutions (services), processes (permits of various kinds) and resources (works of art and artifacts of various kinds). Each of these components interacts in intentional and unintentional ways that it is important to identify for the creation of resilient and adaptive places (Desouza, Flanery, 2013).

Accordingly, it may therefore be useful to define the term *multiresilience*, i.e. the ability of a system to react to a situation of simultaneous presence of multiple risks and, taking into account the peculiarities of the place, the characteristics of the individual risks, the participation of the various subjects in a perspective of inclusion, and return to the initial situation.

Starting from this premises, aim of this work - carried out in the framework of the research project PRIN 2020 SUMMA "Sustainable modelling of materials, structures and Urban spaces including econoMic-legal iMplicAtions" – within the ISMed-CNR Unit (with the author's responsibility) and the relative agreement between Sapienza Università di Roma and ISMed-CNR - is to define multiresilience and multiadaptation starting from the concept of resilience and adaptation and present the synthesis of a the Cittaducale case study carried out with an *ad hoc* method.

2. Planning the complexity of the unexpected

Spaces that have a good degree of resilience are spaces capable of adapting to change. It is also true that adaptation, like resilience, is a term that lacks a univocal interpretation (De Roo, Porter, 2007).

To clarify its limits in the design field, it is possible to bring this field back (De Roo et A. 2020) to the material dimension and to the organizational and institutional dimensions. The material dimension concerns people, the environment and the territory, while the organizational and institutional dimensions concern the domains in which planning and activities act to link institutions with the material dimension. Adaptive planning can therefore lead to: that the people, places or situation being planned have a dynamic behavior and may exhibit such behavior in the future; o that the processes for designing and implementing interventions are likely to be adaptive.

The uncertainty and unpredictability of an event and its subsequent, often unknown, development are difficult elements to manage. In fact, the system as a whole cannot be understood only by observing the parts that compose it, which must instead be analyzed together with their context, noting the reciprocal relationships and the ways in which the system reaches the best possible configuration.

Traditional approaches to spatial planning often do not take adaptive behavior as a starting point, believing that interventions can be decided on the basis of facts and estimates available at the time of the decision-making process.

This static perspective is also used in contemporary planning, where deliberate actions will lead to the results of the intended decision. However, assuming a static world can lead to strategies that may be outdated by the time of the decision, leading to a large divergence between the expected and actual effects.

Resilience and adaptation are to be considered fundamental in dynamic planning, where the uncertain and the sudden become components of the planning process with the same weight as the others, and where urban planning tools are renewed or modified to help manage any crises in a adequate way.

In line with the concepts set out above, just as for *multiresilience*, it may also be useful to define the concept of *multiadaptation*, i.e. the ability of a system to react to a multi-risk and unexpected situation by creating a new balance capable of taking into account the specificities of the territories, types of risks, actors involved and new needs of people.

Multiadaptive planning - due to its complexity - to be suitably designed needs the support of an *ad hoc* methodology, as illustrated below.

2.1 The protocol of investigations

The proposed original method has the purpose of identifying which are the present or possible risks, both single and above all multiple, that may affect public spaces, the factors that determine them, the perception that users have of these risks and project interventions for a multiadaptation that aims at the same time to enhance the quality of the places. The final product is represented by two maps, one that systematises and integrates all the data collected separately in the previous phases in order to obtain a mosaic of risks, factors, user perceptions, and the other that presents the identified multiadaptation and enhancement project interventions.

The first phase concerns the analysis of the place with the identification of the single present or presumed urban risks. This is carried out by detecting these risks with the use of a specific database: the risk is detected through the observation of the places and it is quantified with respect to its presence in slight, medium and significant.

The present risks that can be detected from the observation include: the risk of degradation, the environmental risk, the social risk, the cultural risk, the anthropic risk, the seismic risk, the health risk, the risk of low liveability, the risk of insecurity, the risk of loss of place identity.

This survey is connected to the subsequent one concerning the factors that can determine the risk, since the risk is detected through the identification of these factors. It is therefore a mainly qualitative survey as it is based on the observation of the place.

The second phase is carried out by observing which elements and factors influence or can influence the present or possible risk or risks. This observation is carried out with a database which indicates the type of risk identified and the factor or factors that determine it.

Factors that can determine risk include: lack of shelters or shelters in open spaces with extreme temperatures; presence of mass tourism in historic places; poor state of conservation of public places and spaces including floors, furnishings and equipment; presence of buildings without maintenance; presence of fast food, street vendors and shops selling poor quality products with use of the street for display in historic places; presence of environmental events such as floods or seismic phenomena, albeit periodic; presence of architectural barriers; presence of furnishings, equipment, maintenance with little attention to the identity of the places. For example: the anthropic risk can be determined by factors such as mass tourism, territorial marketing actions; pedestrianization of a single road within the tourist route; the environmental risk can be

determined by earthquakes or floods; the urban unliveability can be determined by low quality design of spaces and scarce maintenance of furnishings and equipment.

The result is a mosaic of factors that influence or can influence the emergence of risks of various kinds.

The third phase concerns the observation and analysis of the effects that may occur if several risks analysed in the first phase occur or may occur simultaneously.

The data collected concern the type of risk, the effect or effects and the relative quantity of the effect detected, indicated as slight, medium or significant. For example, if the public space concerns a city affected by seismic risk or flood risk and at the same time the space has been created or rebuilt with a design that pays little attention to the identity of the places, the place will not fulfil its function as a place for socialization, as the lack of security could be joined by that of the perception of space not linked to tangible and intangible cultural aspects.

The result will be a mosaic of the risks present with their effects and quantities detected.

The fourth phase concerns the risk perception questionnaires. In this phase, two types of surveys will be carried out: the first relating to the perception of the risk by the people who use the place, through the administration of a questionnaire; the second related to the perception of the place present on social networks - including Facebook, Tripadvisor, Instagram, Twitter - from where to extrapolate useful information for the study being carried out.

Questions that will be asked include:

1. What general perception do you have of this place?
2. Do you think this place is affected by one or more types of risk?
3. What perception do you have of the risk or the risks to which it refers?
4. Do you think that these are permanent or transitory risks?
5. How do you think citizens can contribute to the resolution of the risk/s?
6. What are the quality of this place?

This aspect of the analysis is very important as from the answers it will be possible to understand how much and if people perceive each risk and if they think they can contribute to their resolution.

The fifth phase concerns the identification of the plans, programs and policies that are active in the place under analysis. An overview of the area will be carried out and research on the actions, if any, aimed at mitigating the different types of present or possible risk will be carried out. These can be on different scales and of different types, of a general nature or very specific and sectoral.

The product will be a sort of mosaic of plans, projects, programs and policies that may be present in the territory in question which will make it clear whether the risks under analysis are already object of attention and what actions, if any, have been undertaken.

The sixth phase is the identification of the quality factors and elements of the place.

The identification of the quality of the place is understood here as the presence of historical monuments of interest, historical buildings, public spaces with good quality design, easy accessibility, greenery, historical urban fabric, perspective views. The identification of the presence is also linked to the current use. This information is important to understand what resources that place possess and if the uses of it can be flexible.

The result is a mosaic of the quality elements of the place with their relative uses. The seventh phase concerns the multiple risks analysis, i.e. the creation of a map that presents all the risks which are present. The map will contain: all the risks present in relation to public spaces; the factors that contribute to the perception of present or possible risk; the results of the questionnaire on risk perception by people and those identified on social networks; and the quality elements of the place with its use.

The eighth phase consists in identifying the dynamic potential of the area. In this phase, by observing the multi-risk map, the most flexible spaces for resilience and improvement/enhancement project are identified. The result will be a sort of mosaic where areas of greatest risk are indicated where an action of adaptation and improvement/enhancement is most necessary.

Finally, the ninth phase will be the identification of the multiadaptation project interventions, located in the areas already surveyed in the previous phase. These project interventions concern the possible actions to be carried out to *multiadapt* to the risks and at the same time enhance the places. The result will be a map that will identify flexible interventions to be implemented both in the case of risks that are already present and of possible risks.

3. The case study

By way of example, the case of Cittaducale in the province of Rieti - Lazio Region in Italy -, which was affected by an earthquake in 2016, will be summarized in the following. Despite it was not having suffered major damage as several other nearby centres, the place is subject, also for effect of the earthquake, at risk of depopulation and isolation.

I will summarize the example, reporting the results of the phases of design, namely, phase 7,8,9. The seventh phase concerns the construction of a mosaic map where risks, user

perception and quality of the place are identified. The risks identified in this city are the seismic risk, depopulation risk, isolation risk and the identity risk. From the interviews carried out, the most perceived risk is the seismic one, probably due to the enormous damage of neighbouring countries, while the least perceived is the pandemic one detected by only 30% of the interviewees. The risk of depopulation and that of isolation are mentioned, as they are closely linked to each other, and in some way the consequence of the other.

Regarding the quality, the regular layout of Cittaducale allows even the occasional visitor to be able to orientate easily, its small size and a liveable atmosphere favours the slow and pleasant walkability of the town. The network of narrow streets surprises in the sudden glimpses of the green of the mountains or the valley. In some places the roads open towards small open spaces used mostly for parking. There are numerous historic buildings that arouse interest along the route such as the Dragonetti-De Torres, in Baroque style located in the middle of the upper course, or the buildings that house the pupil's school and the former forestry dormitory, an important and historical presence for Cittaducale since 1905.

The eighth phase concerns the identification of flexible areas, or the parts of Cittaducale where it is possible to think of a multiadaptive project capable of accommodating different types of activities also with a view to enhancement.

The identified areas concern in particular the squares and open spaces of the historic centre that are little used, buildings and churches of interest and routes.

The first spaces identified are those used for parking that can be allocated to initial reception areas in the event of earthquakes but also for socialization and participation.

Then the numerous squares and open spaces to be connected to the central Piazza del Popolo in the redesign of the urban path to rebalance the attractiveness of the square and at the same time improve its liveability in periods such as the summer when it is little used. Other flexible areas concern the streets on the edge of the historic buildings, creating both a cycle-pedestrian path that connects these places of identity value, promoting sustainable mobility, and a connection between the railway stations and the already existing cultural tourist train.

Finally, the naturalistic-archaeological-religious itineraries, where small orientation and rest areas can be created, also inserting areas to be used for outdoor sports activities.

In the last phase, mutiadaptation project interventions are identified to enhance the qualities of Cittaducale by mitigating the various risks identified, enhancing its cultural resources and powering the already existent liveability atmosphere. To this end, four paths have been identified including architectural, landscape/naturalistic, religious, and

arts and crafts.

In the architectural path it is possible to cross the squares of the historic centre - without architectural barriers - which will be used for initial reception areas in case of earthquakes, socialization, and enhancement of prestigious buildings of various eras in all other periods. The traces of the arcades incorporated into the building, the stone portals, the towers and bell towers become references for orientation. The route then opens towards the ancient city walls extending towards the archaeological area and the Church of S.M. di Sesto which reciprocally become the beginning and end of the path.

In the landscape/naturalistic path Cittaducale can be connected to other hiking trails and paths, including the European route E1 (from North Cape in Norway to Capo Passero in Sicily, South of Italy), reshaping the place with its wider context. From this, which becomes of main interest, other paths and trails branch off that touch naturalistic areas where various outdoor activities can bed carried out, also useful in periods of physical distancing (e.g. 1-2 meters among people) due to Covid-19 pandemic restrictions.

In the religious path it is possible to visit the churches through an itinerary of sacred architecture that also includes a stop at the episcopal museum and the library museum of Santa Caterina up to the Capuchins as a place of meditation and contemplation. This path is linked to two interwoven paths incorporating that of San Francesco da Greccio, Rieti, Poggio Bustone up to Borgo San Pietro on Lake Salto and that of San Felice da Cantalice from the Sanctuary of San Felice all'Acqua to the house where he lived located in Corso Mazzini.

Finally, in the path of the arts and crafts, abandoned and disused production areas could be recovered for the transformation of local products and the creation of workshops / accommodation, in underused buildings, for new skills by strengthening native crops to be recovered and enhancing the Terme di Vespasiano with its healing waters. This path is in particular designed to involve in different ways locals and fragile people.

Suitable info points, Qr Codes and a web portal with apps to be downloaded by place users will report paths and show their characteristics and information concerning areas for first recover in case of seism or physical distance in case of pandemic and all useful information in period of crisis.

In this way, the various identified risks - seismic, depopulation, isolation, identity, pandemic - could find resilience, transforming them into opportunities for enhancing Cittaducale in sustainable way.

4. Observations

The proposed method was experimented in areas characterized by different types of risks.

This is a method which follows a holistic approach and that was created by the author to analyse and design complex urban situations where the presence of multiple risks makes the place in question particularly subject to degradation, disuse, unliveability or depopulation.

A method that can identify at the same time factors, risks and people's perceptions can support a sustainable project that is more attentive to urban situations where the coexistence of several overlapping crises makes resolution difficult. In addition, users' perceptions are of great importance to understand their awareness with respect to important issues affecting the space in question.

During the experiments, some observations came up, which will be reported below.

The main problems include: the survey of the risks, the indication of the risk in quantitative terms; the users' perceptions and flexible area identification. Indeed, risks cannot always be predicted, as it is easier to understand the vulnerabilities than the risks; the coexistence of several risks has different effects according to the risks that are added together, the places where they occur, the percentages in which each risk occurs.

The presence of a poor state of preservation of public space and little accessibility can predict a situation of disuse or degradation; but the presence of seismic risk and little accessibility, does not necessarily lead to degradation, as the seismic event may not occur for many years. Similarly, the presence of mass tourism together with a low quality of design of the places can predict a cultural risk and a loss of identity of the places. The presence of mass tourism together with the risk due to climate change could also result in a decrease of tourism due to difficult climatic conditions and therefore paradoxically to a better maintenance of the place.

Another aspect concerns the indication of the risk in quantitative terms, that is light, medium and considerable. Indeed, the presence of a risk is due to changing factors and therefore defining mass tourism as a risk for the identity of that place probably means approximating the quantity detected to a specific period of time (e.g. spring or summer). Furthermore, indicating the due effects of multiple risks in quantitative terms requires averaging as each effect will present different quantities of risks.

Furthermore, every mitigation and enhancement must be planned on the single site.

As regards the users of the places, they perceive the risks only if these occurred recently or if these persist over time, therefore the answers to the questionnaires must be adequately integrated with the information collected in the inspections.

Again, the collection of information on social networks requires a survey with parameters

that can change from time to time depending on the type of risk to be detected, and, in any case, a complex interpretation of the data for the purpose of the case study.

And, finally, the flexible areas that are identified can be such even only in certain periods and for this reason the project interventions can refer to more or less long periods of the year.

The potentials include in particular the method itself and the detection of quality factors for enhancement of the resources which are identified. As a matter of fact, the flexibility of the method makes it applicable to areas of different types and for different types of risk and the repeatability of the method, thanks to a survey protocol organized by phases and products, can be applied by everyone.

Accordingly, the other important potentialities include: the possibility of identifying enhancement and risk resilience interventions that derive directly from the results of an analysis; and the detection of risks from a qualitative point of view, that is linked to the intangible characteristics of a place and its cultural heritage. Furthermore, the qualities of a place must also be noted with respect to the potential of the surrounding areas.

There are many users to whom the method is addressed: to citizens in order to share vulnerabilities and risks and participate in their resolution; administrators to understand, also from a qualitative point of view, the various risks of the territory and how to transform them into an opportunity to enhance cultural resources; to technicians, to identify flexible project areas for different uses; to tour operators, local product companies, businesses in general, in order to offer their products in an integrated manner.

Finally, the general idea is that the risk can be an opportunity to review aspects of the territory that can be improved and enhanced and therefore multiresilience and multiadaptation can be interpreted as a component of sustainable regeneration (Sepe, 2021-2023).

5. Conclusions

Resilience often considers the events that cause a crisis in a system to be equal even if they have different characteristics and does not distinguish sudden events from unwanted ones, leading to some ambiguities. Among these, for example, since there is no definition of how to pursue it, the degree of resilience of communities after a sudden event may not be the same and even within the same community different behaviours may occur.

It is also true that adaptation, like resilience, is a term without a univocal interpretation.

Consequently, I have proposed the terms of multiresilience and multiadaptation to frame the behaviours of a place in situations of multiple risks that are increasingly occurring in

contemporary territories. *Multiresilience* is defined as the ability of a system to react to a situation of simultaneous presence of multiple risks and, taking into account the peculiarities of the place, the characteristics of the individual risks, the participation of the various subjects in a perspective of inclusion, and return to the initial situation.

Multiadaptation is meant as the ability of a system to react to a multirisk and unforeseen situation by creating a new balance, capable of taking into account the specific features of the territories, types of risks, actors involved and new needs of people.

The various case studies that have been carried out have led to the identification of guidelines, always following the idea that the risk can be an opportunity to review aspects of the territory that can be improved and enhanced and therefore resilience can be interpreted as a component of sustainable regeneration. The case studies include: Cittaducale and Leonessa in Lazio Region, Siena, Naples, Paris, Madrid and Rotterdam. The case studies have been chosen for the presence of one or more present or probable risks: Cittaducale and Leonessa are interested by seismic risk and depopulation; the historic centre of Siena, Naples and Madrid by mass tourism and globalization; Rotterdam and Paris by flood and possible lack of place identity as regard the first and mass tourism as regards the second.

According with the concept of flexibility and multiadaptation, the following guidelines are meant as an output that can be continuously updated depending on possible new kind of risks or combinations of them which could be detected in further case studies.

The identification of the dangers related to a place must take place in a preventive manner, through analyses involving material and immaterial factors.

1. The multi-resilience/adaptation project should be meant with a holistic approach.

2. The identification of risks and possible damages must take place with reference to more potential events that can occur simultaneously.

3. The perception that the population or, more generally, the user of a place has, is a fundamental element in the study of dangers and risks and must be detected through ad hoc questionnaires.

4. Fragile individuals must be taken into particular consideration both for the survey of their perception of risk and for the project of adaptation to them.

5. The survey of the urban qualities of the place - cultural heritage, materials, equipment - are elements to be considered in multirisk multiadaptation projects/policies, in order to transform them into opportunities to improve its liveability.

6. The multi-resilience/adaptation project must be constantly monitored in order to be able to foresee sudden events and to be able to react in a sustainable manner.

7. Flexibility is one of the essential characteristics of the multiadaptation project and must be understood in an inter-scalar (from the building to the city) and interfactorial way, integrating urban, socio-economic, cultural and environmental aspects.

8. A multi-resilience/adaptation project cannot be used in any place even if characterized by the same risks, but must be carried out respecting the different characteristics, as each site (historic centre, suburbs, regeneration area) has its own peculiarities to take into consideration.

9. The communication of dangers and risks as well as of projects, plans and policies for multi-resilience/ adaptation must be carried out in an appropriate manner for all age groups and abilities.

10. New technologies must be used to support both the communication of risks and dangers. And the disclosure of all the measures adopted or to be adopted in the case of a crisis of various types, should be clearly and widely illustrated through ad hoc web portals, apps, social networks, sensors, interactive maps.

These principles are the results of the different case studies carried until now; because uncertainty is at the base of multiadaptive planning, new guidelines can be added if an update will be necessary.

At the same time, the experiments carried out so far have verified the validity of the method and its protocol of investigations, but because of its flexibility, as for the principles, also the method can be updated if different types of risks peculiar to other places will be detected.

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