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Risk - Uncertainty - Complexity and Foresight as Alternative Planning Tools for Natural Disasters: The Medicane 'Ianos' in Greece

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Summary

The complexity of the modern world and the growing uncertainty brought about by multiple challenges compose a mosaic of questions that require answers. Increasing risks as a result of climate change, along with circumstances that society has not been able to predict before, such as the Covid-19 pandemic, create complexities that make the future particularly unpredictable.

Spatial planning, inextricably linked to societal processes, is an area that can significantly contribute to addressing the above challenges of the future.

In light of the above, this article attempts to investigate particular aspects of the hazards caused by modern phenomena, especially in urban areas. It combines the adoption of appropriate practices for assessing complexity, investigating uncertainties, and mitigating the risk of decisions. In doing so, it seeks to move to the level of foresight, arguing that overcoming vulnerability and the pursuit of resilience are meaningless for the planner unless contextualized within a forward-looking perspective with responsible planning.

The above analysis also makes use of a case study conducted on the effects of medicane 'Ianos' that struck Greece in Autumn 2020[1]. The results reveal the weaknesses of planning, the spatial system, and the ways that one could imagine recovery and progress.

Keywords: natural disaster, risk, uncertainty, complexity, medicane Ianos, planning, foresight

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Natural Disasters[2] and Urban Systems

In recent years, we have witnessed many extreme weather phenomena, such as the floods that hit Western Europe (in Germany and Belgium during the summer of 2021, for example). In 2020, Greece also experienced a cyclone named 'Ianos'. Are these completely random phenomena?

Most modern risks[3] are multi-hazard[4] and make their identification and management particularly demanding since most are inextricably linked to the management of climate change. In this case, as in the case of the Covid- 19 pandemic, because the spatial scale of the challenge is global, there is a need for local governance to also globalize and for global recommendations to be implemented at the local scale.

The above-mentioned hazards know no borders since the response of each state affects the whole 'global community' (Beck, 1992). This is why international institutions like the UN have turned their attention to the commissioning of a series of policy papers with good practice on resilience-based approaches to the future of disaster management, such as Agenda Hyogo 2005-2015 and Sendai 2015-2030 (UNISDR, 2015; 2005).

The definition of disaster, because of its high degree of complexity, presupposes the inability of society to manage it with its own resources (UNISDR, 2009). If one, in addition, considers the spatial constraints where a specific social system operates, then space becomes a further component of complexity, and it is thus very possible that the spatial system, whether a city or a state, would be unable to cope with or to recover. Otherwise, the hazard would not turn into a disaster.

However, the need for multi-level disaster response is widening, as are the components we are called upon to manage in order to prevent the development of disaster risk. According to Hansson and Aven (2014), despite the fact that risk analysis and assessment is a scientific process, questions always arise that cannot be answered by science alone.

The concept of 'uncertainty'[5] is at the heart of disaster theory, as it is directly linked to potential threats (Rosenthal et al., 1989). However, uncertainty can lead to potential threats or not. An assessment of uncertainties may specify the factors that can cause hazard or crisis[6] and mitigate decision risks and their disastrous consequences.

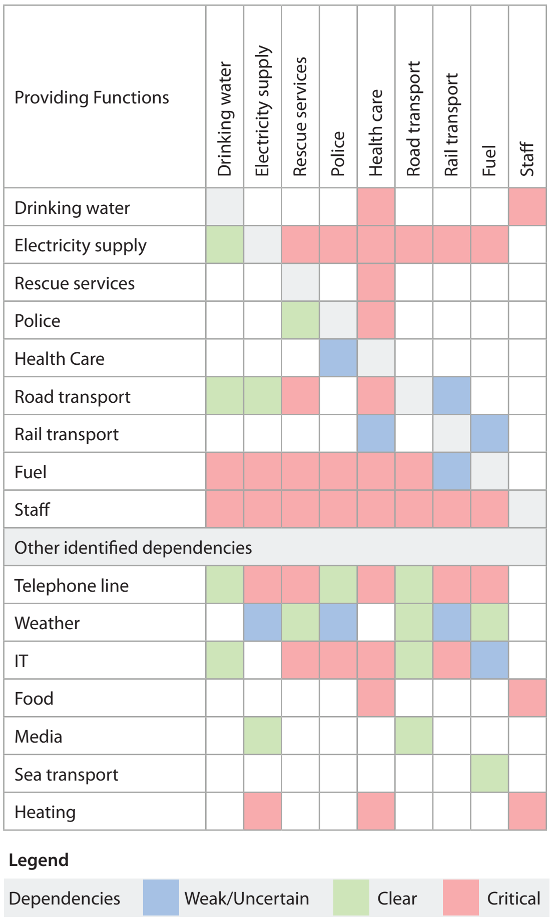
Disasters reflect vulnerability[7], a factor that adds to the risk decisions that make up planning and spatial policies (Delladetsimas, 2009, p. 87). Urban space is the focal point of a wider complex of socio-economic, political, and environmental interconnections (Castells, 1983), therefore the analysis of its vulnerability is based on the historical context of shaping society's relations with space. Because cities exhibit such dynamism in flow capacity (power, capital, information, etc.), they are also at the forefront of disaster governance and are at the heart of international efforts to reduce risk through a conceptual framework that minimizes the vulnerability and underlying risks of a disaster as a whole, so as to avoid, prevent, or limit (through mitigation and preparedness) disaster impacts and facilitate sustainable development (UNISDR, 2009, p.10). Due to the complex nature of an urban system, vulnerability analysis must be based on a systemic approach so that it can be representative of reality. The individual characteristics and subsystems of the city show different degrees of exposure[8] and vulnerability to a hazard, while the management capacity of each subsystem varies depending on the hazard and on the interdependencies of the subsystems, producing high levels of complexity.[9]

For this purpose, the city is not treated as a single system, but as a supersystem of the subsystems that compose it, with these being the infrastructure and functions that serve the daily needs of its inhabitants (figure 1). These include housing, the water supply and sewerage networks, energy and transport networks, social and public facilities, and services, among others (Wamsler, 2014). These subsystems interact with the characteristics of the urban fabric, such as the urban ecosystem, society and culture, the urban economy, and governance (Batty, 2008a). The above are the subject of urban design and planning and at the same time key variables in disaster management strategies.

Complexity, Uncertainty, and Risk in Planning

In the present context, we adopt a systemic approach in order to serve the analysis and investigation of the triptych of Risk-Uncertainty-Complexity (RUC), always in a specific historical context. In the case of disasters[10], it is necessary to divide the components, even those seemingly unrelated, which affect urban space and its 'behaviour' in a hazard, or disaster.

Figure 1. Dependencies of Urban Systems and Functions



Source: Wamsler and Brink, 2014.

The turning points of an urban system, such as a natural disaster, are a function of its complexity (Batty, 2008b), and because these points cannot always be predicted they produce uncertainty and risk. The multiplicity of the character of an urban system (natural, built, historical, and social, among other dimensions) composes the context of the analysis, which is one of the critical factors in assessing complexity. The diversity and interlinked factors of urban systems, which are generally complicated and multilevel, cannot be determined with absolute accuracy. Their subsystems, however, can be broken down into individual characteristics and the complexities they present. In addition to the complexity of each context that is analysed, uncertainty arises from the different forms and degrees of vulnerability of the system (Batty, 2008a). Exposure and hazards also produce uncertainty about the consequences they may have (Rossetto, 2008). Furthermore, the techniques and practices of the production of space in each context can in turn create uncertainty, as the decisions made in each case are limited by those of the past (path dependency) and by previous layers of development even if the context is different. If there is no uncertainty, there is no risk (Cardona, 2003). The risk analysis framework defines the limits, causes, purpose, and interactions in terms of the system's ability to manage them and the factors that cause them. At the same time, opportunities and constraints for planning may emerge. Additional, subjective risk factors include the stakeholders and their involvement in integrated risk management and decision-making processes, as well as the institutional tools to reduce it (e.g., specific legislation, codes, etc.) (figure 2).

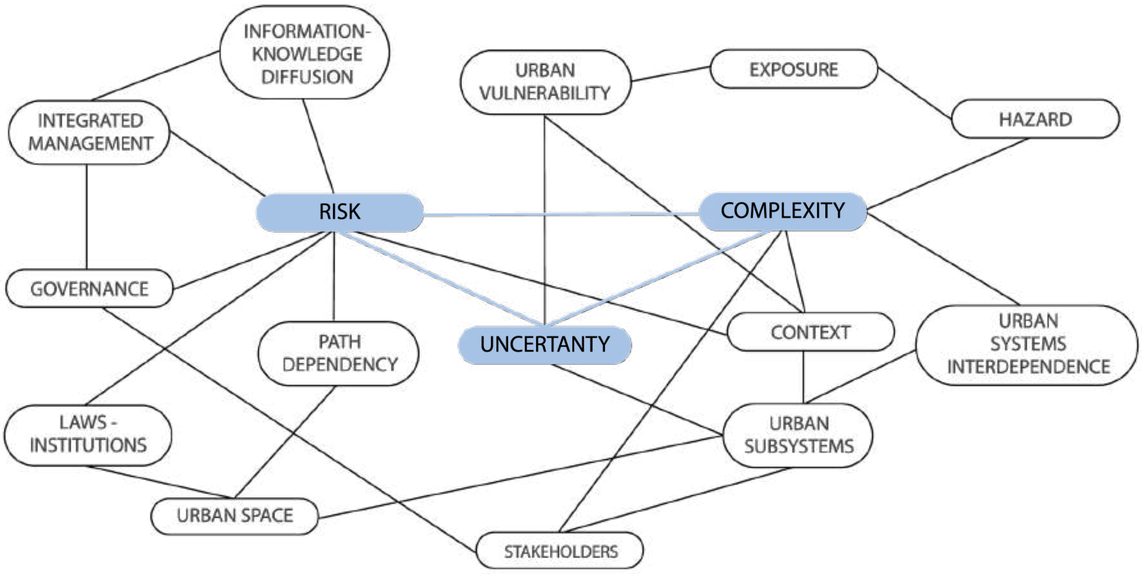
Because however, the city exhibits systemic behaviours, disasters have domino effects that are mutually dependent. For example, serious damage or destruction of historical and cultural heritage sites can affect tourism, which has an impact on the economic activity of the city and ultimately on the way of life of the inhabitants. Therefore, the planning stages according to the Disaster Cycle (figure 3) (i.e., relief, reconstruction, disaster preparedness, and risk reduction) require analytic tools in order to increase their effectiveness and secure comprehensive management of the complexity of the impact.

In the proposed disaster management framework with the adoption of RUC analysis, the first step is to investigate the complexity of dependencies of the different factors (or sub-systems) affecting the spatial system (Dimitriou et al., 2013), as well as the potential effects of a hazard. The analysis concerns all stages of the Disaster Cycle (or Spiral of Destruction[11]), from prevention to rehabilitation (figure 3). Complexities produce multiple uncertainties at all stages. For example, at the stage of the response, the complexity underlying the architecture of the urban spatial structure (in the case of an earthquake, for instance) creates an uncertain degree of response by the population with regard to the required evacuation speed and degree of understanding instructions. Consequently, the decisions made even carry the risk of death.

The Foresight Exercise

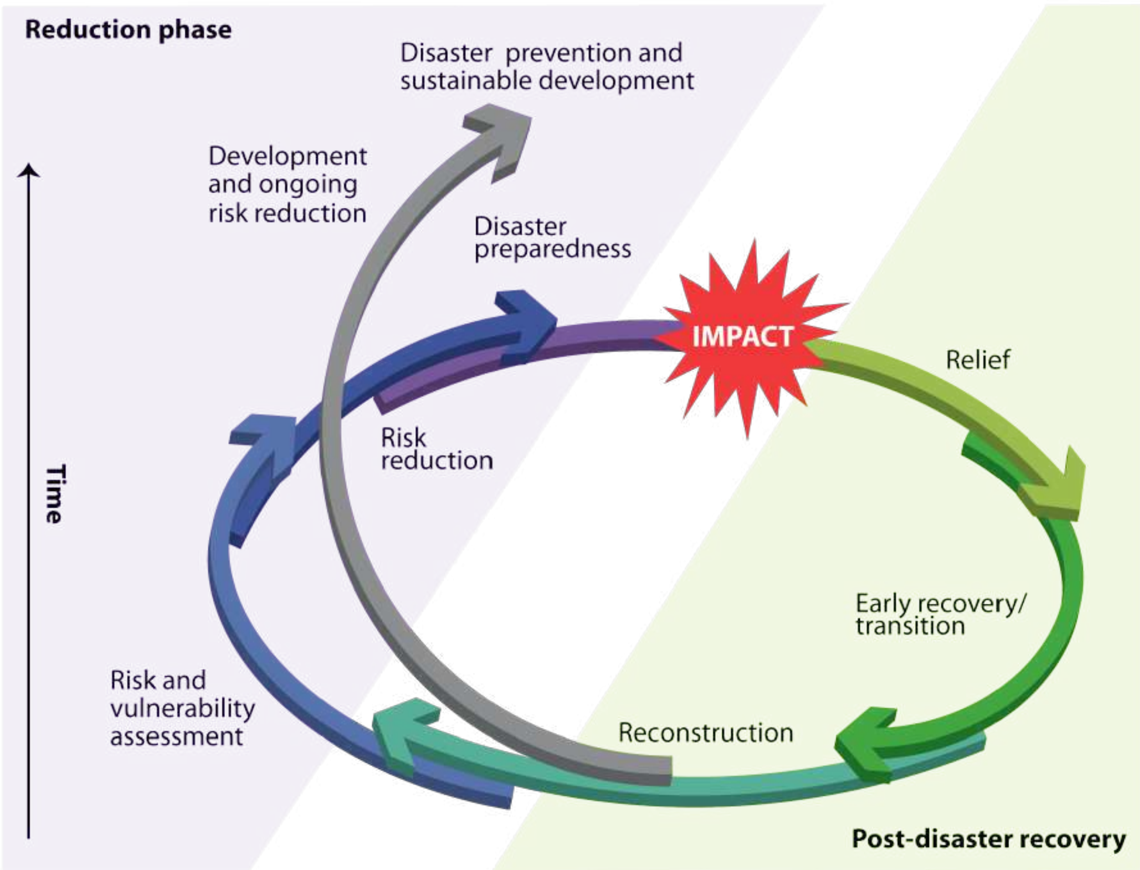
The future is unknown and human society is complicated and complex. Yet we can know (or imagine) certain things. One such tool for understanding the 'next period' is the foresight exercise, which requires a thorough analysis of the current stage, which is already complex and entails uncertainty and risk. The RUC causal sequence, at

Figure 2: Linking Risk - Uncertainty - Complexity in the Context of Urban Disasters



Source: Authors' own elaboration.

Figure 3: The Spiral of Destruction



Source: RICS, 2009.

its core, creates the need to use tools to identify and investigate the uncertainty we are called upon to address in planning. To identify uncertainties, future needs, and opportunities in the context of strategic planning (Mietzner and Regner, 2005), and to seek possible actions that could influence long-term trends (and therefore, change the future in a favourable way (Martin, 1995)), we propose a combination of risk management approaches and foresight procedures applied together in this analysis. Foresight tools can use the information obtained from this analysis to outline and shape the desired, but otherwise unpredictable, future.

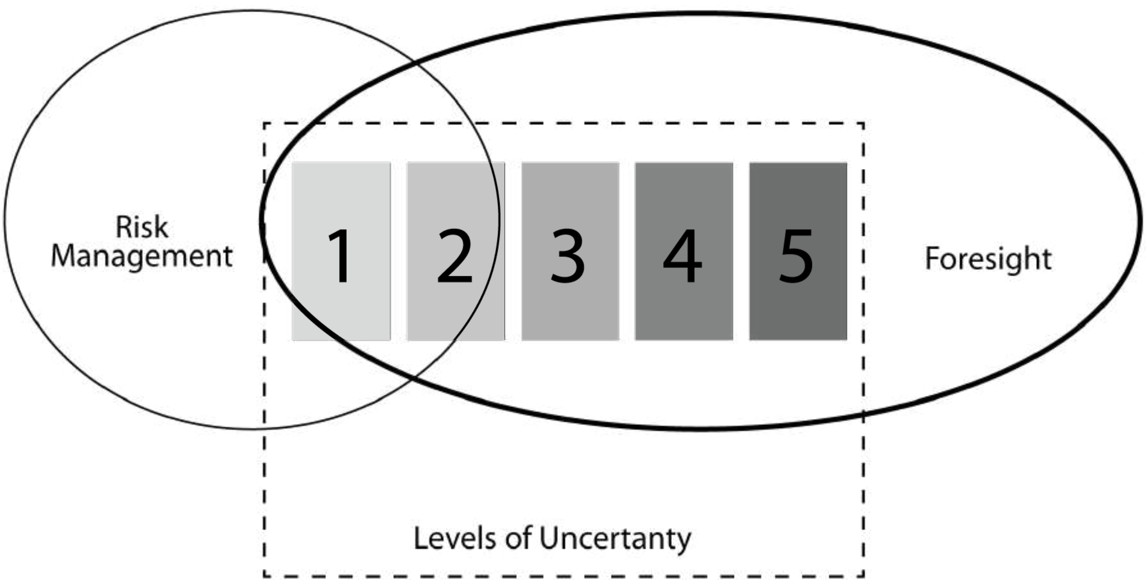
In the stages of risk management and assessment for planning prevention, preparedness, and rehabilitation at the urban level, it is crucial to identify the complexities of urban systems and the uncertainties they produce, resulting in increased risk. As Batty argues, when we plan for cities or look at planning decision-making processes, the way we interpret their complexity also changes (Batty, 2008b).

The interpretation of the above complexity in combination with the fact that the future is becoming more and more uncertain is necessary for the field of disaster management. In the cases where uncertainty is high, the application of foresight methods can assist its management in the course of consultations. Hence decisions will be more efficacious and bear lower risk.

Some uncertainties can be identified, while others are completely unknown. Walker et al. (2013) identify five levels of uncertainty: the first refers to a clear enough future - a situation with no absolute certainty; the second regards alternate futures with probabilities - forecasts associated with probabilities; the third refers to alternate futures with ranking - based on alternative assumptions; the forth is a multiplicity of futures - no ranking is feasible or there cannot be an agreement because of limited knowledge or data; the fifth concerns an unknown future - we know that we do not know. These levels of uncertainty are also depicted in figure 4.

Risk management and the implementation of foresight practices are considered particularly critical in the early stages of the management cycle. However, since the process is endless, risk management through foresight evolves through feedback and continues to take place in the later stages of the management cycle as well, such as during and after the end of the disaster or the appearance of danger. Integrating foresight practices is crucial in the context of risk management. Prospective investigative processes have recently begun to be integrated in the field of disaster management (since 2005), with researchers combining different practices, such as scenario building (Birkmann et al., 2015; Scawthorn et al., 2006), cross-impact analysis (Banuls et al., 2015), predictive models (Papadopoulos et al., 2017), determination of the degree of uncertainty and trend impact analysis (Birkmann et al., 2015) and simulations (Watson et al., 2015). In particular, in the academic field, scholars have been attempting to combine prospective investigation tools with the risk management framework (Aubrecht et al., 2013; Jahangiri et al., 2017; Beddington and McLean, 2012).

Figure 4: The Governance of Hazard-Risk and Uncertainty Ratings



Source: Jahangiri et al., 2017.

According to Beddington and McLean (2012), it is possible to safely predict 13 different hazards over a time horizon until 2040, with earthquakes being the exception. However, the 'driving forces' (social, economic, technological, and environmental) can reverse projected trends and lead to structural change (Saritas and Smith, 2011). The cause-and-effect relationship between a hazard and the expected results is not clear or perceptible in all cases. Some phenomena and hazards have never happened before and others that have happened in the past may not happen again in the future. In addition, the effects are unique in each case, as the frame of reference changes, which in turn is also unique. In such cases, the complexity is high while the situation is typical of chaos.[12]

Complexity management requires pattern management and the filtering of prospects, while chaos requires immediate action to address the crisis and the use of tools to bring about a state of stability in the system (Kurtz and Snowden, 2003). These characteristics can relate to emergencies, which influence the vulnerability of a system, the number of components exposed, or even the potential of a hazard.

But how do we move forward in practice?

In the framework of foresight, this analysis is expected to be performed by experts with the outcome provided to all participating groups so that further results can be produced after processing.

The foresight framework we vision in the context of disaster risk management follows the principles of participation and interdisciplinarity, since these two concepts can form a sufficient and necessary basis for the governance of risk management decisions (Cardona, 2003). This framework follows the logical sequence of some basic steps. After the analysis and organization of the relevant data (Voros, 2003; Popper et al., 2008), the agreement on a common terminology among the stakeholders (Keenan et al., 2003) follows the application of the most appropriate and compatible methods depending on the disaster/underlying risks that the decisions seek to address. These methods can be qualitative, quantitative or semi-quantitative (Popper et al., 2008) and must be able to be combined and adapted as needed.

Some methods that are preferred and already used in disaster forecasting applications include the use of 'weak signals[13]' to detect 'wildcards' by highly specialized teams (quality methods), i.e., the detection of cases of high uncertainty that, if they occur, will have serious consequences (Petersen and Steinmuller, 2009). Some quantitative methods that can be used include an analysis of indicators/time series through available statistical data in order to describe, monitor, and measure the evolution and current state of disaster-related components to assess changes over time (e.g., changes in flood risk trends when foresight concerns flood risk decision management, etc.) (Popper, 2008). The production of new ideas is offered by the possibility of combining explicit and implicit knowledge for the effective management of disaster risk decisions and leads to the further development of future-oriented knowledge and mutual consensus (Saritas, 2006). In this way, the scenarios for the desired future are formed (Jahangiri et al., 2017) as well as the central vision on which the formulation of the strategy will be based.

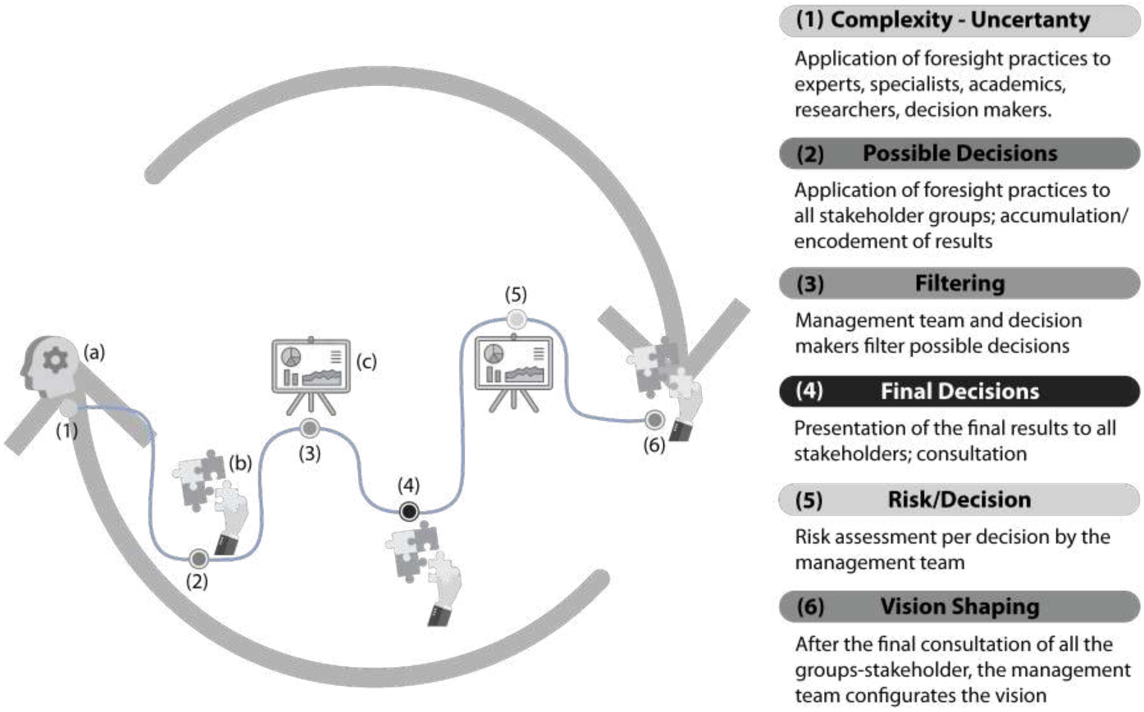
Combining RUC and Foresight

The integration of the RUC process into a foresight framework concerns the decisions being made about risk and the shaping of scenarios (figure 5). So, if we use a RUC analysis framework for urban hazards in terms of vulnerability and exposure that shape the risk, taking into account a specific risk, the first steps of a foresight framework demand that the complexity of the urban system is analysed, and the uncertainties caused in terms of future risks are appraised. In the next steps, the possible responses and decisions are identified.

Then, the possible decisions are filtered through indicators and other tools to reach final decisions, thus identifying the risk involved in each group of decisions (Zafeiriou, 2021). Then, the degree of risk is determined, and the possible acceptable alternatives are identified with the objective of shaping a future vision. This produces a matrix with all the above components (figure 5), presenting a complete picture of the process from the analysis to the vision. The more data that is entered (and the more specific that data is), the more detail and scope the decisions can have.

The next step is to filter decisions, where indicators, research studies, good practices, and models can be used. For example, some indicators of the United Nations Sustainable Development Goals and the Global Risk Index (UNISDR, 2015; Birkmann et al., 2015) can be very appropriate. The filtering is followed by the formulation of final decisions by identifying the risks for each category of decisions. In the final decisions that emerge, an evaluation of the proposed actions is first carried out by the decision makers (Voros, 2003). Then the alternative scenarios are prepared with the participation of all stakeholders, the final scenario is selected, and the overall strategy is formulated, including the changes and actions in the chosen direction (Popper et al., 2008). Within the above framework, we attempt to analyse the medicane 'Ianos' that struck Greece in 2020.

Figure 5: Conceptual Display of the Feedback Application of RUC and Foresight in Disaster Management Processes



Symbols: (a): Desk-work foresight, (b): Participatory foresight, (c): Strategic foresight

Source: Author's own elaboration.

The Mediterranean Cyclone 'Ianos' in Greece: A Case Study

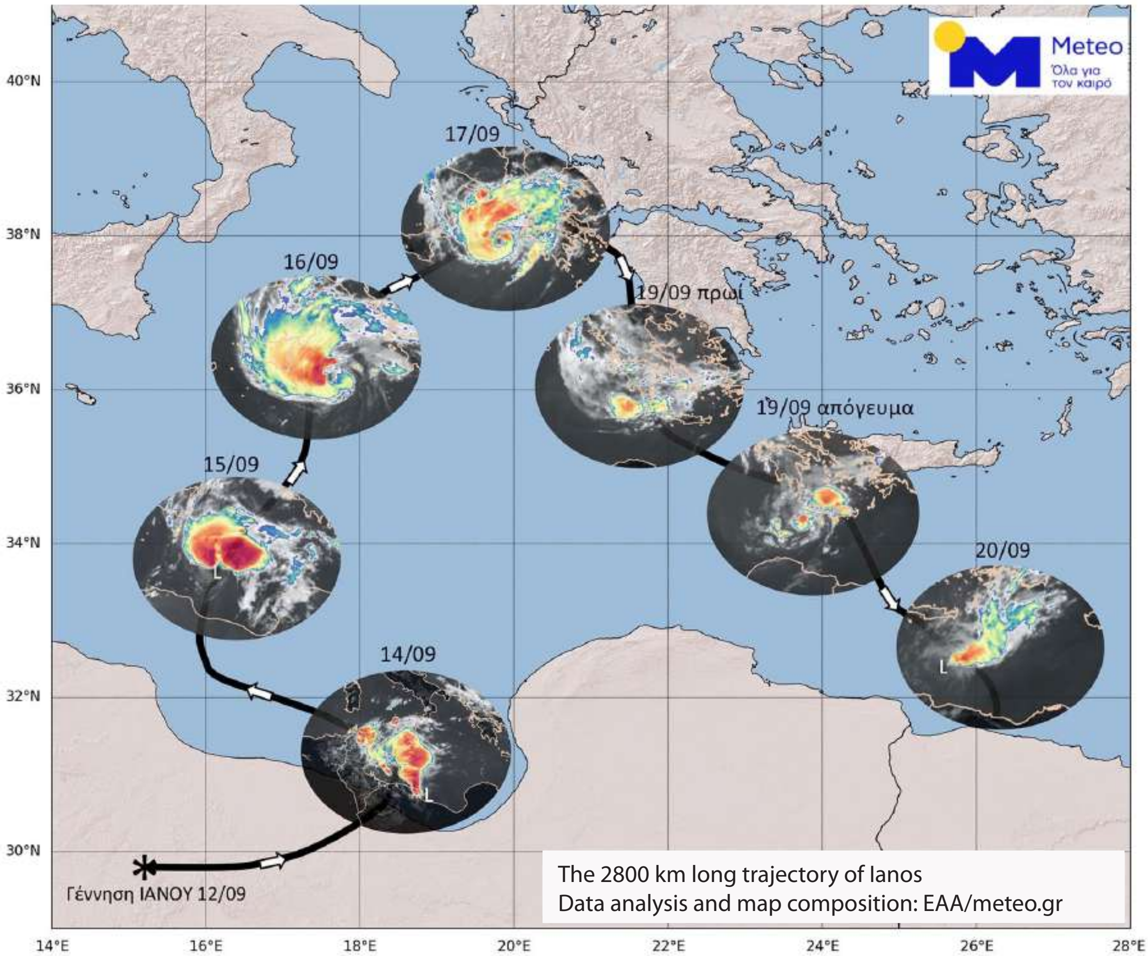
'Ianos' began to develop in the Gulf of Sirte (Libyan Sea region) of the North African coast on September 14, 2020, heading towards Greece in the following days (figure 6) (Lagouvardos et al., 2020). On September 17, 2020, it began to head towards Thessaly.[14] The long duration of the rainfall and its intensity ranked 'Ianos' as one of the strongest Mediterranean cyclones that has been recorded ever, allowing this phenomenon to be characterised as extreme (Lagouvardos et al., 2021).

Our field research focused on four urban areas in the Region of Thessaly, namely the cities of Karditsa, Trikala, Farsala, and Almyros (Zafeiriou, 2021). The scientific community claims that the phenomenon was relatively predictable. Even though the forecast of rainfall from meteorological data and models usually contains a large margin of error, in this case (and specifically for Central Greece) the predicted rainfall was very close to that observed (Lagouvardos et al., 2020). Our approach to understand the escalation of the extreme disaster risk is examined in the light of the evolution of a process and not as a simple individual event (Hewitt, 1983; Blaikie et al., 2003).

Initially, the citizens' warning mechanism was activated by the Ministry of Civil Protection. However, the residents of the Region of Thessaly were not included in predictions of the exposed areas and their warning was delayed. In the past, extreme weather events have caused floods in the area and usually spread to farmland. However, the onset of the Mediterranean cyclone 'Ianos' in the region turned into a disaster as a result of the floods, characterized by the loss of life and property, as well as the damage and collapse of infrastructure networks.

The hazard itself, although an extreme

Figure 6: The Course of the Mediterranean Cyclone 'Ianos' September 12 – September 20, 2020



Source: Meteo, 2020.

phenomenon, was predictable and its consequences were not inevitable. The losses sustained could have been avoided or lessened if vulnerability was lower and if the risk of disaster was addressed at all stages of the cycle (prevention, preparation, preparedness, response, and recovery). Importantly, the causes of the catastrophe do not include a failure of the forecasting models, which had foreseen the expected events with relative accuracy.

Regarding spatial planning, the Flood Risk Management Plan (covering the Region of Thessaly and the River Basins of the Water Department of the Region) was established in 2018 following the incorporation and implementation of the relevant Directive 2007/60/EC of the European Commission and its incorporation into Greek legislation[15], which emphasizes the importance of prevention, protection, and preparedness for disaster risks. Regarding urban planning and flooding in Greece, urban plans have been required to provide for the treatment of natural disasters since the 1980s (1337/83- housing law and EPA) and the 1990s (L.2508/97- sustainable housing development). This does not necessarily mean (unfortunately) that in praxis these planning provisions are applied.

An additional mechanism for flood risk management under Greek law, particularly in the preparation and rehabilitation stages, is provided for in the 'Dardanos' plan, with provisions for "emergency response and immediate/short-term management of the consequences of the occurrence of flood phenomena" (GGPP, 2019). The 'Dardanos' plan was prepared following the principles and specialized needs of the General Plan of Civil Protection 'Xenokratis' (Government Gazette 423B, 10/04/2003) in case of flood. The central goal of this plan is to coordinate the competent bodies at the central, regional, and local level.

This plan comprises four stages of business organization and risk management:

1. Preparatory Actions - Usual readiness (pp. 17-18);
2. Increased preparedness actions in view of the risk of floods - Increased Preparedness (pp. 18-19);
3. Emergency response actions and immediate/short-term management of the consequences of the occurrence of floods - Immediate Mobilization/Intervention (pp. 19-20); and
4. Actions of immediate relief for the victims and immediate/short-term recovery of the consequences of the disaster - Rehabilitation/Relief (p. 21) (GGP, 2019).

Municipalities, regions, and the decentralized administrations of the whole country were invited to complete the appropriate planning in their jurisdictional territory by the end of January 2020. However, in the case of the Region of Thessaly, the approval of the respective plan only took place after a meeting of the Regional Council on September 28, 2020 (Region of Thessaly, 2020), i.e., after the disastrous flood had occurred.

In October 2020, the 'Memorandum of Actions for Responding to the Needs and Immediate/Short-term Management of the Consequences of Flood Phenomena' for the formation of an effective management system was issued following the planning of the decentralized administration of Thessaly-Central Greece (Decentralized Administration of Thessaly-Central Greece, 2020). Therefore, in both cases, there was no formal planning for the emergency and the governance of the consequences of a possible flood before 'Ianos.' In the case of the municipalities, where the present work focuses (Farsala, Karditsa, Trikala and Almyros), and according to official website posts in 'Diavgeia'[16] (Diavgeia, 2007) and representatives from the Civil Protection Services of the regional units who participated in this research, there is no local plan at present. In conclusion, actions and decisions for emergency management at the local level were not made according to a comprehensive, formal plan, but according to the discretion of the local authorities and depending on their means, experience, and knowledge.

Although Greece is among the 187 UN member states that have ratified and adopted the Sendai Framework 2015-2030, its actions appear to be limited to the systematic integration of risk reduction approaches, the implementation of preparedness programs, and response and rehabilitation in emergency cases (Strategic Objective 3), as well as enhanced preparedness against disasters at all levels (Priority 5) (UNISDR, 2015). The Greek state has maintained the Greek National Platform for Disaster Risk Reduction since 2012 as an open system of services and institutions. Yet, its contents are limited to some disaster-related scientific articles and minimal official reports (PreventionWeb, 2007).

In this frame, the present research was conducted concerning the disasters caused by the Ianos Medicane in Greece (Autumn 2020). The purpose of this research has been to evaluate the management capacity of the competent bodies, the available tools and plans, and the protection and preparedness policies for the relief and restoration of urban-residential areas of Thessaly. The research was structured in three parts, each containing a set of questions (See Box 1).

A Summary of the Responses of the Interviewees

In this section, a brief summary of some of the most pertinent responses of the interviewees will be presented.

The first question concerned the causes that contributed to the evolution of the flood risk in disaster. The main points of convergence in the answers were the severity of the meteorological phenomena, the intensity and magnitude of the flood risk (22.4%) and the absence of basic preventive actions, such as the clearing of riverbeds, streams, and torrents (22, 4%). Other responses attributed the disaster to secondary phenomena (landslides) (3%), insufficient infrastructure (14%), geomorphology (12%), human intervention (construction methods and practices) (12%), coordination of relevant services (10%), and basic prevention-cleaning actions of riverbeds, rivers, and torrents (22%). The category of answers 'other' (3%) includes answers that referred to political decisions and difficulties in estimating the territorial extent of the flood.

Following the first question, respondents were asked to state their opinion about the concentration of uses in unsuitable areas or areas of high risk. In particular, how much the risk is increased by the violation of legislation with arbitrary construction or even by ill-advised planning of critical infrastructures in the above areas. According to the interviews, inappropriate land uses that contributed to the increased risk included the lack of implementation of land use planning (14%), the legalization of buildings

Box 1. Method of Research

Eighteen in-depth interviews were conducted with individuals who were divided into four target groups: competent bodies and services of the region, members of local government units, academics, and a wider group that included engineers and members of volunteer groups.

The questions of the semi-structured interviews were categorized into three parts according to their content and their relation to the theoretical framework, analysed in this paper:

1. The first part (Questions 1-6) dealt with the factors that contributed to the escalation of the risk in the context and the effectiveness of existing flood protection and response tools, which led to the disaster (complexity, uncertainty, risk).
2. The second part (Questions 7-10) focused on the means and mechanisms of flood risk governance and decision making (hazard and risk governance).
3. In the third and final part (Questions 11-13) the focus was on policies for the future (resilience/sustainability) and prospects (hazard and risk governance).

The constant comparative method was applied for data analysis (Glaser and Strauss, 1967, p. 105).

by derogation (19%), inappropriate land use planning (24%), and other causes. The 'other' causes mentioned were the complete lack of available resources (e.g., Forest Maps, Land Registry/cadastre, etc.) for the mapping of properties and the configuration and disposal of updated data (representative of the Region), the obsolete building stock in settlements and cities (representative of a group of experts and volunteers), and the issue of off-plan construction in high flood risk areas (representative of the academic community). Some also believed that the issue of arbitrariness and inappropriate siting of uses is due to the inability to coordinate competencies.

The third question in this category concerned the nature of protection and restoration projects, in particular their relationship to their uncertain carrying capacity for future hazards. Half of the respondents in all of the represented groups believe that prevention and restoration projects are not designed and implemented based on their effectiveness for future needs (50%). Instead, rehabilitation or service needs are governed in an ephemeral and superficial way. In addition, some of the respondents representing specialist and volunteer groups, as well as the academic community, argue that such projects are hampered by chronic pathogens, past bad practices, and other pressures (15%). Furthermore, most of those coming from the local authorities consider that the projects that are carried out only concern restoration (15%). Finally, it is argued that projects are mainly aimed at restoring accessibility and not at other equally important areas of protection and rehabilitation (20%).

Finally, with regard to post-emergency relief measures, respondents were asked to state their views on whether or not one-off relief measures are a sufficient and necessary condition for the recovery of individuals and companies and are sufficient for future development. Responses from all four represented groups referred to the best allocation of resources and to shortcomings in these measures, such as horizontal allocation, the provisional recording of losses, and the fact that some benefited while others did not receive adequate care (12.5%). Some claimed that compensations are not enough, and some procedures are bureaucratically problematic, hindering immediate provision to the victims (31.25%). In addition, it is argued by representatives of all four groups that the measures of one-off compensations and facilities are not sufficient for substantial recovery and future development (19.35%). Finally, a large percentage of respondents believe that such measures should be the starting point for a comprehensive strategy to address the problems that the victims will be called to face (35.48%).

In responses about the adequacy and effectiveness of the group of specialists and members of voluntary groups, as well as representatives of the local government units, it is claimed that existing plans are not sufficient and effective (47%). Respectively, members from all represented groups suggest that the plans can be made effective and adequate under certain conditions (47%), such as:

- If and as long as they are incorporated into legislation and into building and urban planning regulations;

- If the appropriate training and frequent preparedness exercises are carried out in the competent bodies and services;
- If there is proper coordination between competent bodies and security forces involved in emergency management;
- If there is adequate staffing in human resources and the necessary means-equipment are provided to the competent services; and
- If the population is informed and educated about flood risks and their governance.

Finally, one representative of a local government unit considered the plans to be effective and sufficient.

In the second part of the interviews concerning risk governance, the first question investigated the human resources of the governance bodies and their specialization, as well as the allocation of resources at the level of decentralized administrations (regions and municipalities) for the appropriate planning of prevention and protection projects aimed at mitigating risks and impact. Most of the interviewees in all groups consider that the human resources are insufficient in number and/or in specialization (44%). A smaller percentage claims that there is adequate staffing and sufficient specialized staff in the competent management and planning bodies (22%). However, some argue that while human resources exist, they do not have the necessary specialization, vision, or new ideas (17%), or that they are not utilized and do not receive necessary training on issues of risk or disaster (6%). Finally, some argue that there are sufficient and specialized human resources in the regions and their competent services, but not in the municipalities (11%).

In particular, it is strongly argued that the regions and the municipalities do not have the necessary resources for such projects (41%), while resources are channelled primarily into restoration projects rather than in prevention (35%). Furthermore, some respondents (members of local government units) believe that there are many failures in the projects that are funded and carried out for this purpose, which make them ineffective (e.g., speculation of the concessionaires of the projects, etc.).

Regarding the means of collecting, processing, and disposing of information and data (e.g., meteorological stations, flood risk data processing software, disaster statistics), the majority of respondents consider that they exist but are not sufficiently utilized (47%). Others (53%) think that while there are state-of-the-art technological means, their universal use and the complementarity they may have with other means has not been achieved yet (e.g., geographic information databases for the estimated risks).

Another parameter of risk and risk governance is the degree of involvement of civil society, vulnerable groups, academia, experts, and other collectives in the stages of the disaster cycle. The issue of participation has many readings. Given the possibility of electronic consultation carried out in the case of planning, the majority of respondents consider that this tool, while used, has only an advisory character. That is, it is unable to contribute substantially to decision-making (43%). Still, some argue that there is a lack of social mobilization for participation in the consultations (19%). The contributions of relevant volunteer groups in the processes are considered to be important, but their knowledge, positions, and role are often marginalized or underestimated (24%). Finally, an additional factor in assessing the contribution of participation in risk governance is the lack of public interest and awareness of risk and disaster issues (14%), which can be attributed to the lack of information and education on this issue. As for policies (Part 3), there were two key questions: The first concerned the formulation of a governance strategy for the underlying risks of disaster, such as in this case, the flood caused by 'Ianos'. In this question, participants were asked to choose between formulating such a strategy at the local, regional or national level, or a combination of levels. The most common answer was that the formulation of such a strategy is necessary at all three levels, with synergies and specializations of responsibilities (47%). The next most common answers were those that argued that it would be useful to develop strategies at a national and regional level (18%) or regional and local level (18%). Strategy formulation at the national or local level received less support (6% for each response). For the most part, the key level of intervention is regional, but no one has argued that a future strategy should be purely regional.

The heterogeneity of responses to the causes of disaster testifies to this complexity, both in terms of the characteristics and effects of flood risk (severity of phenomenon, secondary disasters, etc.) and of the built urban space (infrastructure, unsuitable land uses, etc.).

When it comes to decisions on rehabilitation projects and relief efforts, the combination of the vulnerability of urban systems and subsystems, as well as the characteristics of the built space and environment (e.g., off-plan construction, incomplete design implementation, installation in high flood risk areas) generate multiple uncertainties. These uncertainties relate to the adequacy, essential contribution, and carrying capacity for decisions to meet the needs of the present and potential hazards of the future. The risk that arises as a logical consequence is that the projects that have been decided and are being implemented collapse in the face of a new, extreme hazard. According to Greek legislation, the management of decision risks falls under the central or regional level of administration and is connected to the appropriate staffing of the competent services, but also to governance mechanisms in general. In the sphere of risk governance, while the technological means are sufficient and able to support the integration of foresight processes, the necessary parameters of participation and interdisciplinarity at the institutional and practical levels seem to be missing. Frequent political interventions equally turn into an impediment and make the implementation of the process impossible.

Risk reduction and governance policies/strategies may, according to respondents, be preferred at the regional level. Yet city networks within regions are at the heart of risk and risk management. Disasters still significantly impact cities through the disturbance of operations and infrastructures defining urban systems. Furthermore, since the extreme conditions of disasters resemble chaos, the breaking points of the urban system can only be approached at high levels of uncertainty, e.g., through a foresight exercise; if they were predictable, they would be easy to manage, and disaster chaos would be prevented. Although this does not mean that the scenarios that can be formed can always prevent or reduce the impact of a disaster, from the point of view of governance, it is necessary to first deconstruct the data of the possible disaster with RUC analysis and then reassemble it through hrough a foresight exercise. The combination of the two approaches aims to base future management tools on three time-points:

- Past: Complexity - Path dependency
- Present: Uncertainty - Systemic Behaviour - Interdependence - Governance
- Future: Risk - Vision - Strategy.

Conclusion

In Greece, significant steps have been taken to improve emergency management in the event of many different hazards, as the institutional framework now exists at both national and decentralized levels. However, the stage of prevention and protection, before the disaster and also after its end since it is a cycle (restoration is the first step of prevention for the future), still presents many weaknesses. A substantially mandating framework for prevention and protection projects is lacking and the specifications of these projects do not meet the uncertainties of the future. In addition, necessary actions are not taken to upgrade the prevention and protection infrastructures of the built space, society and its activities, and the natural environment. However, with the use of existing tools and the adoption of new ones (such as those under consideration), comprehensive disaster risk governance can be implemented at the regional level, in synergy with cities and settlements.

As has emerged from the research on flood risks in the Region of Thessaly and disaster management around 'Ianos', there is a big gap in terms of a comprehensive disaster risk reduction plan at the central, regional, and local levels. That is, the strategic part of the governance of the disaster cycle is missing and is ultimately determined a *posteriori* by executive decisions and operational actions at various levels of governance. The main goal of the 'Dardanos' General Plan for decentralization and distinct allocation of competencies, "cooperation, synergy and interoperability of the stakeholders at the central, regional and state level" (GGPP, 2019, p. 2), does not seem to have been achieved. The main shortcomings of the plan are the lack of necessary scientific and technical staff for the preparation of projects by competent bodies, the fact that the means are not secured, and the lack of resources committed in the state budget to regions and municipalities for the effective operation of services and support of the civil protection operational plans assigned to them.

A central issue that arises is that the Greek state does not seem to treat flood disasters (or other hazards) as a cyclical process that begins and returns to the stage of prevention and requires modern strategic actions and planning. Instead, it adopts an *ex-ante* approach under an implicit rationale that if or when an event occurs, they will deal with it, which ends at recovery. Of course, this problem is not exclusive to Greece. Other countries have yet to face the frequency and severity of the dangers triggered by climate change. This, for example, is evident in the recent floods in Rhineland-Palatinate in Germany, which was characterised as a 'national disaster' (Georgakopoulos, 2021); devastating fires in Turkey, Bulgaria, Northern Macedonia, Albania, Kosovo and Croatia in the summer of 2021 (Eurotopics, 2021); and in the recent fires in Greece that burned more than 100,000 hectares of forest and pasture (August 2021).

The problem with this approach is that actions and decisions are not integrated into a strategy that results from a holistic approach to system vulnerability or exposure, nor do they enhance the carrying capacity of response and management. Simple assessments, however useful, are not enough for comprehensive risk governance. This is why governance procedures are necessary.

These procedures should include the assessment, the promotion of the necessary feedback of decisions with sufficient data, and the composition of necessary actions. These actions will aim at the indication of an accepted level of risk and its understanding by all participants. Apart from the fact that such an approach can be characterized as more democratic, compared to a purely top-down technocratic approach, it can make the greatest contribution to a common vision through the application of foresight practices in the process. A perpetual, constantly fuelled risk governance, at the regional and/or local level, can lead to commonly agreed decisions and, at the same time, recommend effective strategies to reduce future uncertainty. Nevertheless, the framework proposed in the theoretical part of this article for applying foresight procedures to a decision risk governance approach seems to be significantly different from reality.

However, more and more serious disasters indicate the usefulness of integrating foresight into risk governance in parallel and in combination with RUC analysis. Specifically, in the case study prepared, according to the disaster management cycle, the Thessaly region is still in the process of restoration, almost a year later. Apart from the fact that the process seems to be extremely time-consuming, rehabilitation must emerge as the appropriate stage to feed decisions on the identification of complexity factors, such as the dense network of rivers, streams, and torrents in small catchments that cross towns and settlements and create uncertainty about their response to new flood risk. These uncertainties that arise in the decisions for projects, actions, and planning must be evaluated and examined to know if decisions made are sufficient and capable of ensuring that such consequences will be avoided in the future.

Analysing the RUC factors for urban/residential environments revealed the complexity of the widespread concentration of unsuitable land uses in river flood zones, and the uncertainty of their impact in the event of a new flood. Alternative decisions that could be made include the relocation of the above uses through a land bank and the planning of new suitable uses in these areas. Another alternative is to reinforce embankments and other precautionary measures to shield already installed uses. In both cases, there is a risk that projects fail to respond to a new potential hazard, causing dissatisfaction among residents, possible environmental degradation, and/or degradation of the urban landscape.

In conclusion, the tools and approaches proposed in this analysis can be considered as methodological frameworks to be used systematically and effectively in all phases of the disaster cycle, from different areas of interest, specific to the needs and context. Modern practices, cutting-edge technologies, the availability and dissemination of information, and existing tools and mechanisms, combined with the integration of new and modern additional tools, can make planning more effective in mitigating risk and reducing the intensity, extent, and cost of impact.

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Notes

1 A 'medicane' is a meteorological phenomenon similar to a hurricane or cyclone occurring in the Mediterranean Sea.

2 Disaster: "A serious disruption of the functioning of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability and capacity, leading to one or more of the following: human, material, economic and environmental losses and impacts" (UNDRR/ISC, 2020, pp. 52-53).

3 Risk: "An uncertain consequence of an event or activity with respect to something that we value" (Dimitriou et al., 2013, pp. 1-2).

4 Hazard: "A process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation" (UNDRR/ISC, 2020, pp. 52-53).

5 Uncertainty: "An expression of confidence about the state of knowledge in/about a given situation, often relating to the future" (Dimitriou et al., 2013, pp. 1-2).

6 The concept of 'crisis' is difficult to define. In the context under study, in terms of the characteristics that govern it, a crisis is defined as specific, unexpected, and unpredictable events or a series of events caused by or causing high levels of uncertainty and threat […] to important targets (Seeger et al., 1998).

7 Vulnerability: "The conditions determined by physical, social, economic and environmental factors or processes which increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards" (UNDRR/ISC, 2020, pp. 52-53).

8 Exposure: "The situation of people, infrastructure, housing, production capacities and other tangible human assets located in hazard-prone areas" (UNDRR/ISC, 2020, pp. 52-53).

9 Complexity: "Complexity arises in a system when a great many components interact simultaneously in a complicated form" (Dimitriou et al., 2013, pp. 1-2).

10 The concept of RUC in the present analysis originates from the OMEGA-Project contribution, which examined a number of megaprojects for their multidimensional sustainability in synergy with RUC management in planning decisions for their planning and implementation (Dimitriou et al., 2013).

11 The basic components of the risk assessment framework and all the individual stages of management are inextricably linked to space and time, prevailing conditions, and other factors that shape the context of reference. This is the main reason why the further elaboration of the concept of management 'unfolds' the circle and creates an infinite spiral.

12 Chaos (chaos theory) is the "unpredictable behaviour in simple, bounded, deterministic systems. Such behaviour is extremely complicated because it never repeats, and it is unpredictable because of its celebrated sensitive dependence on initial conditions: even extremely small amounts of vagueness in specifying where the system starts render one utterly unable to predict where the system will end up" (Kellert, 2008, pp. 5-6).

13 These are incomplete and fragmented data, from which, however, important information can be drawn (Petersen & Steinmueller, 2009).

14 Thessaly is the main region of Central Greece (east).

15 Article 9 of Joint Ministerial Decision 31822/1542/ E103 (Government Gazette 1108/ B'/ 21-07-2010).

16 At https://diavgeia.gov.gr/ all Acts of public, regional, and municipal interest are posted online, to ensure transparency.

Disclosure statement

No potential conflict of interest was reported by the author.