Doctoral Dissertation
Doctoral Program in Urban and Regional Development (36°cycle)

When the plan is not enough

Civil Protection Emergency planning for effective Disaster Risk Reduction

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October 16th, 2024

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Allegra Eusebio
Turin, October 16th, 2024

Summary

The research work here presented is framed in the wide discourse concerning Disaster Risk Reduction, focusing the attention on the relation between emergency management, emergency planning and spatial planning. Empirical recognition – coming from previous research work and confirmed by the literature – of a biased approach to emergency management and planning is what switched on my interest on the topic. Emergency planning is often dismissed by planners for being too dedicated to action, lacking a deeper thought on the territorial implication of the operational decision of emergency plans. Likewise, practitioners in charge of emergency management seem not to consider the spatial implications of their operational choices, underestimating the importance of a complex understanding of the territory in risk reduction practices . This lack of interaction among emergency operational management, dynamic understanding of the territory and territorialization of practices, creates disconnection among mitigation, preparedness, response and recovery, the four phases of the disaster cycle, hindering the cooperation of the various players that – in different roles - deal with risk as well as with the various instruments involved.

Starting from this general consideration, the present project is articulated around two guiding hypotheses. The first one concerns the central role played by spatial planning in all the four moments of the disaster cycle, therefore including preparedness and response, the emergency-related phases. Several aspects of spatial planning can, in fact, give a valuable contribution to contingency planning, not only helping rescue operation, but also enhancing the rebound of disaster-stricken territories and community. This leads to the second guiding hypothesis, which is that emergency planning is not to be considered just an operational activity nor a static sort of goal, but rather it should be regarded as a process, including governance implication and strategic territorial perspective. The planning process itself, not the planning outcome, should be the object of evaluation, as it is the instrument that connects all the different pieces of the disaster cycle puzzle.

Based on this, the research question is structured as follows:

How can emergency management and planning trigger effective Disaster Risk Reduction in spatial planning?

Hence, focusing on the emergency-related phases of the disaster cycle, considering the complexity of DRR and including the multiplicity of stakeholders and instruments that play a role in the process, the final objective of the research is to define practices, tools, and areas of intervention that can serve as a bridge between emergency planning and spatial planning.

This aim is achieved through a case-study methodology, analysing two specific activities of the Italian Civil Protection, a central stakeholder of the emergency management system: the execution of a national Civil Protection exercise, the *EXE Sisma dello Stretto,* and the participatory process for the drafting of the Civil Protection plan in the town of Bagnara Calabra (RC). These two activities were chosen as they represent key moments of the disaster cycle, as well as important elements for the description of a bounded system as the one of the Civil Protection. Comparison is not the objective of the analysis. On the contrary, the combination of the two experiences results in the creation of context-dependent knowledge to which the Disaster Risk Reduction gaps identified in the theoretical framework were sought after.

The dissertation is organized in three sections.

Part I: Disaster Risk Reduction. A comprehensive framework develops the theoretical framework of the topic. The focus of this section is the deconstruction of the concept of risk, in order to move from the early conceptualisation based on environmentally deterministic approaches, to a more holistic risk concept that integrate environmental, social, economic, political, infrastructural and governance-related issues. This is instrumental for questioning the concept of effectiveness in Disaster Risk Reduction, developed as complementary to the DRR Gaps: risk assessment, risk awareness and risk governance. The outcome of this first phase of the research gives the key for the development of the following one, as it defines the critical issues that will be highlighted and deeply investigated in the fieldwork: subdivision of competence among actors of the disaster cycle, knowledge transfer risk-related, digital transition, policy implementation and temporality of activities.

In the second phase of the work, *PART II. Case study analysis: the Italian Civil Protection System*, the focus is on the empirical recognition of the critical categories identified in the first part, through the analysis of selected case studies. As for the risk knowledge category, the analysis aims at understanding if and how the civil

protection activities analysed contribute to the creation of risk knowledge and if this is efficiently transmitted and used. Deeply connected to the risk knowledge category, there is the one of risk awareness. Here the objective is to define if the emergency management and planning activities influenced community's and involved actors' risk perception. Moreover, the connection between risk perception, risk awareness and willingness to act will be investigated. Finally, as for the risk governance category, the reconstruction of the connecting network will provide a synthetic framework of actors, territorial scales and temporal scales, in order to explicit competences, contradictions and overlaps of the risk governance system.

Third and last section of the dissertation, *PART III. Planning effectively for Disaster Risk Reduction*, regards the elaboration of the results obtained by the analysis and the proposition of guiding areas of intervention and instruments that can help in the construction of the common foundations for an integrated approach in emergency and spatial planning.

Data collection is made through qualitative methodologies, using instruments such as direct observation, informal and semi-structured interviews, participation in meetings as well as analysis of documentation and critical review of plans and norms related to the subject. Given the highly operational nature of the research topic and case study, the fieldwork assumes a central role in influencing the research development.

The analysis indicates a significant shortfall in the effectiveness of Civil Protection practices and planning instruments to implement effective Disaster Risk Reduction measures within spatial planning. This inadequacy stems partly from limitations within Civil Protection practices that fail to address gaps in DRR identified in the literature. Additionally, there is a lack of recognition of the vital role that territorial issues play in emergency management and planning, which directly affects DRR initiatives. While operational and procedural elements are essential components of the Civil Protection plan, territorial considerations are often treated as secondary, thereby diminishing the overall effectiveness of risk management strategies.

To address these shortcomings, the research suggests some guiding development areas, aimed at integrating emergency and spatial planning.

First, the research proposes the implementation of a DRR relational database, an operational tool that enhances the disaster cycle model by systematizing connections between stakeholders, information, actions, timelines, and data. This aims to clarify the complex processes observed, allowing for better coordination of

communication across different phases of the disaster cycle.

However, the database must be supplemented with concrete actions involving relevant stakeholders. Ultimately, the research advocates for a shift from the traditional Civil Protection plan to a Strategic Civil Protection program, encompassing both operational and spatial components.

In conclusion, the study's contributions are dual. First, through the systematization provided by the DRR relational database and the suggested Civil Protection strategic programme, the work aims to offer an agile tool for understanding the relationships among the different actions, tools, and actors involved in the emergency-related phases of the disaster cycle, facilitating risk reduction interventions. Second, the work seeks to initiate a theoretical reflection on Civil Protection emergency planning, a topic rich in operational and technical studies but lacking in-depth reflection on the nature of its instruments and practices. The integration of Disaster Risk Reduction into spatial planning requires a nuanced understanding of both the procedural and strategic dimensions of planning, necessitating a holistic approach that bridges the gap between emergency management, emergency planning and spatial planning.

Acknowledgment

I would like to acknowledge the Department of Civil Protection, expecially in the figure of Paola Pagliara, for letting me partecipating to the many activities which are described in this thesis.

Furtermore, I would like to thank Fondazione CIMA, in the person of Marina Morando, Marco Altamura, Antonio Gioia, Marta Giambelli, Rocco Masi and Chiara Franciosi, for their help during the writing of the dissertation and for including me in the process of participatory planning in Bagnara Calabra.

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Acronyms

CCS: Centro di Coordinamento Soccorsi (*Rescue Coordination Centre*)
CPD: Civil Protection Department
DICOMAC: Direzione di Comando e Controllo (C*ommand and Control Coordination Centre*)
DRR: Disaster Risk Reduction
ECHO: European Civil Protection and Humanitarian Aid Operations entity
ERCC: European Response Coordination Centre
GIS: Geographical Information System
INGV: Istituto Nazionale di Geofisica e Vulcanologia (*National Institute of Geophysics and Volcanology*)
ISPRA: Istituto Superiore per la Protezione e la Ricerca Ambientale (*Italian Institute for Environmental Protection and Research*)
LEC: Limit Emergency Condition (CLE – Condizione Limite di Emergenza)
MUS: Minimum Urban Structure (SUM - Struttura Urbana Minima)
OSS: Osservatorio Sismico delle Strutture (*Seismic Observatory of Structure*)
PNSRS: Programma Nazionale di Soccorso Rischio Sismico (*National Seismic Risk Rescue Programme*)
RAN: Rete Accelerometrica Nazionale (National Accelerometric Network)
RCP: Regional Civil Protection
SDI: Spatial Data Infrastructure
SFDRR: Sendai Framework for Disaster Risk Reduction
SIAM: Sistema Nazionale di Allerta Maremoti (*National Tsunami Warning System)*
SISTEMA: Sala Situazione Italia Monitoraggio del Territorio (*Italy Situation Room for Territory Monitoring*)
WSIT DPC: Sistema Informativo Territoriale del Dipartimento della Protezione Civile (*Spatial Information System of the Civil Protection Department*)
UNDRO: United Nations Disaster Relief Office
UNDRR: United Nations Office for Disaster Risk Reduction

1 | Introduction

1.1 Research context and introduction to the topic

The research work here presented is framed in the general discourse related to Disaster Risk Reduction, focusing the attention on the relation between emergency management, emergency planning and spatial planning.

According to the Sendai Framework Terminology on Disaster Risk Reduction (UNDRR, 2017), Disaster Risk Reduction (DRR) can be defined as the set of actions, strategies and plans aimed at preventing and reducing existing disaster risk, managing residual risk, strengthening resilience and therefore achieve sustainable development. DRR should not be considered a sector itself, but better a practice to be applied across different sectors (La Rocca et al, 2021). Over the past decades, the topic has gained increasingly relevance in the international debate and, with the escalation of climate change induced phenomena, its "popularity" has grown more and more. The discourse about Disaster Risk Reduction is extremely wide, it comprehends both the international community and the local governments, both the academia and the operational activity, as well as a variety of disciplines that range from sociology to engineering.

In the context of this research, the discourse will be addressed by trying to focus attention on the difficult integration of emergency management and planning within a wider context of dynamic territorial development that considers DRR as a structural element. The wide set of practices, planning instruments, norms and actions that belong to the toolbox of the actors in charge of this phase of the disaster cycle will be investigated.

Interest in the topic arises as consequence of previous research work related to Disaster Risk Reduction in spatial planning[1], where the empirical recognition of

1 I have addressed the topic in the course of a research project, funded by Roma Tre University, titled "*Il PROGETTO OPERA: CONOSCERE, RAPPRESENTARE, INTERVENIRE. Un protocollo pilota per la prevenzione e la mitigazione dei rischi ambientali*" (OPERA project: to know, to represent, to intervene. A pilot protocol for environmental risk prevention and mitigation) (Spadafora, 2023). Along this work, the topic of risk in urban planning has been developed, focusing the attention on

a biased approach to emergency management and planning emerged. Both in the limited literature on the topic[2] and in professional practice, the issue of emergency planning has often been dismissed by planners for being too focused on action, lacking a deeper consideration of the territorial implications of the operational decisions in emergency plans. Likewise, practitioners responsible for emergency management tend not to consider the spatial implications of their operational choices, underestimating the importance of a complex understanding of the territory in risk reduction practices.

This lack of interaction among emergency operational management, dynamic understanding of the territory and territorialization of practices, creates disconnection in the flow of actions that happen before, during and after the calamitous event, hindering the cooperation of the various players that – in different roles - deal with risk during the mitigation, preparedness, response and recovery phases (Galderisi and Menoni, 2007; Brown, 2018; Albris et al 2020; Dolce and Di Bucci 2022).

Mitigation, preparedness, response and recovery are the four different phases of the disaster cycle, a model theorised as a paradigm for organising the action of DRR (Alexander, 2002; Smith, 2009). Each phase is characterised by specific actions and tools - not only spatial planning related - and the efficient management of one phase helps in the efficient management of the subsequential, often with overlap of the individual stages. Effective reduction of the level of risk depends on the smooth transition from one phase to the other, in order to draw benefits from experience and feedback (Smith, 2009). This theoretical fluid connection is not often practically implemented, for reasons that range from administrative to technical ones and that will be deepen during the research.

Starting from this reflection, this work aims to identify methods and best practices pertinent to emergency management and planning that enable the activation of structural risk reduction actions within spatial planning. This analysis is conducted through a study of the Italian Civil Protection System, the primary agency responsible for emergency management and planning at the national level. The focus is placed on two specific activities: the national-level exercise *EXE Sisma dello Stretto*, which simulates the occurrence of a massive earthquake in the Strait of Messina area, and the participatory project for the updating of the Civil Protection Plan of Bagnara Calabra, a town in the Calabria Region of southern Italy.

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the role of local administration in the definition of planning instruments useful for risk prevention and mitigation at the scale of small-medium towns.

2 The literature focusing on emergency planning using a urban planning lens lacks a strong theoretical foundation. The topic is often addressed through manuals or by studying empirical cases and can be integrated into the literature stream that deals with risk in planning, drawing from discussions on both resilience and reconstruction. However, it lacks its own specific space. By way of example and without claiming exhaustiveness, some of the authors who have addressed the topic in urban planning include Bertin M., Bignami D., Galderisi A., Menoni S., March A., Neuvel, J.& Brink, A. The positions of this authors and their contribution to the general debate will be deepen in some dedicated paragraph of the dissertation. More specifically the topic will be addressed with a general perspective in paragraph *2.3 Spatial Planning for Disaster Risk Reduction,* while paragraph *4.5 Civil Protection Emergency planning and 4.5.1 Emergency and Ordinary planning in Italy* will analyze the Italian panorama.

1.2 Research question, objective and hypothesis

The work is structured around two guiding hypotheses, which deals with the role of spatial planning in Disaster Risk Reduction and with the importance of the process in emergency planning activities.

Spatial planning must be regarded as a central component in all four phases of the disaster cycle. Historically, the relationship between spatial planning and disasters has been predominantly associated with the recovery and reconstruction phases, especially in a country like Italy, which has experienced numerous disruptive events over the years. Understandably, the topic of reconstruction—focusing on how and where rebuilding takes place—has captivated planners and architects, leading to the development of a significant body of projects and literature. As awareness of climate change has grown, discussions about resilient cities and societies have taken center stage in urbanism debates. With the rise of the resilience paradigm, spatial planning has extended its influence to the mitigation phase. However, preparedness and response—the emergency-related phases—struggle to be fully integrated into the discourse, possibly because planners have traditionally overlooked them for being overly focused on action (La Rocca et al., 2020; Menoni, 2020a). On the contrary, it is essential to recognize the design component and spatial significance of emergency management and planning activities, as these not only impact the effectiveness of rescue operations but also influence the rapid recovery of disaster-affected territories and communities. Various aspects of spatial planning could make valuable contributions to emergency planning, such as enhancing the information provided by models with spatial and systemic considerations.

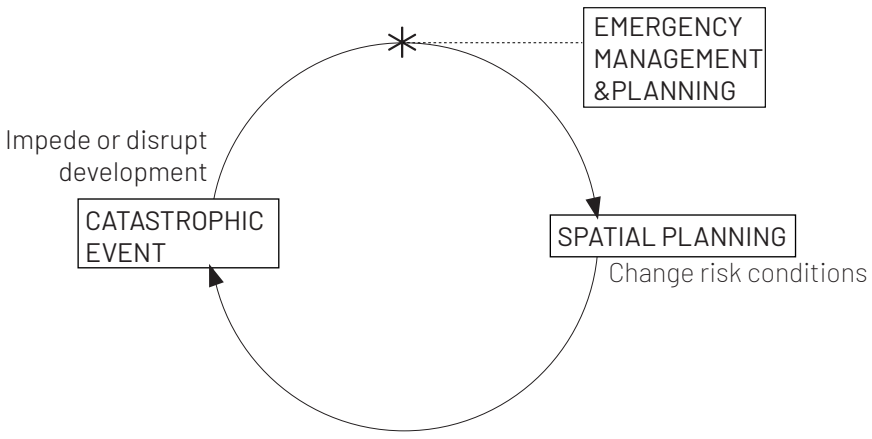

Figure 1. Relation between Emergency management and planning and spatial planning
Source: Author's elaboration

The recognition of the importance of these elements in emergency management leads to the second guiding hypothesis of the work, which is that emergency planning is not to be considered just an operational activity nor a static sort of goal, but rather it should be regarded as a process, including governance implication and strategic territorial perspective (Alexander, 2002). The planning process itself should become the object of evaluation instead of the planning outcome (Neuvel & Brink, 2010). The process of emergency planning should focus on finding solutions and facilitating the negotiation and renegotiation of tasks and the use of available resources when unexpected events challenge established procedures (Menoni, 2013). Thus, the knowledge of the specificity of the territory involved, as well as of strategic assets and administrative and normative constraints is crucial to reach the proper balance among adaptability, observance of procedure and critical regional vision.

Based on this, the research question is structured as follows:

How can emergency management and planning trigger effective Disaster Risk Reduction in spatial planning?

To answer to this broad research question, the work is articulated around two sub-questions and relative objectives that help in the shaping of the research path and match the two main topic the question address.

As for the first, the research investigates ***what is effective in Disaster Risk Reduction?***

The aim of this phase is to build the foundation for the general discourse, providing, primarily, the definition of the basic elements of DRR, i.e. the concept of risk, disaster, hazards, exposure, vulnerability and capacity and then identifying the gaps in the process that lead to ineffectiveness.

Conversely, the second sub-question is more related to the planning field: ***which are the instruments and tools for the integration of emergency and spatial planning?***

For this step, the objective is focused on the planning process, for the definition of actions, instrument and practice which can become points of connection for the integration of those two fields.

Based on the hypotheses outlined above, the ultimate goal of the research is to define practices, tools, and areas of intervention that can serve as a bridge between emergency planning and spatial planning.

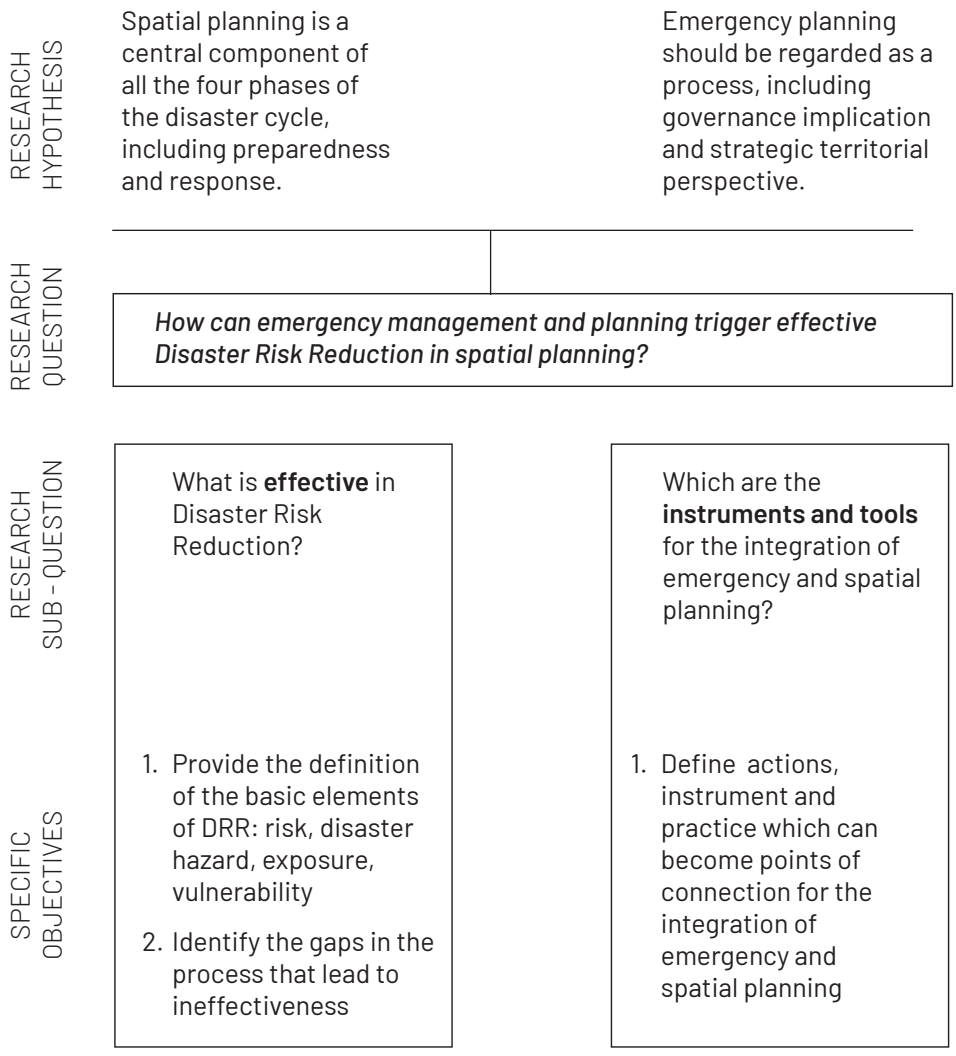

Figure 2. Research question and objective of the study
Source: Author's elaboration

1.3 Methodology

The research is divided in three different phases, that correspond to the three parts in which the document is organised. These phases are rather interdependent entities, drawing upon the information and experiences garnered from one another and often unfolded simultaneously.

The objective of the first phase, *Part I. Disaster Risk Reduction: a comprehensive framework*, is the definition of the theoretical framework of the research and the identification of the critical issues that the literature recognizes as the elements that hinder the effectiveness of the process of Disaster Risk Reduction.

The dissertation starts with the determination of the concept of risk, to move from the early conceptualisation based on environmentally deterministic approaches, to a more holistic risk concept that integrates environmental, social, economic, political, infrastructural and governance-related issues. In this phase, the relationship between risk and planning is further explored through the description of the tools and approaches that have contributed to the evolution of the discipline over time. This phase of the work is instrumental in defining the critical categories through which the analysis of case studies will be conducted. These categories encompass various areas: firstly, the realm of risk knowledge, particularly concerning the transmission of knowledge and digital transition applied to territorial knowledge, understood as a project instrument; secondly, the realm of risk awareness, investigating the connections between knowledge, awareness, and willingness to act; and finally, the realm of risk governance, reconstructing the networks that connect all the different actors involved in the various phases of the disaster cycle.

In the second phase of the work, *PART II. Case study analysis: the Italian Civil Protection System*, the focus is on the empirical recognition of the critical categories identified in the first part, through the analysis of selected case studies. As for the risk knowledge category, the analysis aims at understanding if and how the civil protection activities analysed contribute to the creation of risk knowledge and if this is efficiently transmitted and used. Deeply connected to the risk knowledge category, there is the one of risk awareness. Here the objective is to define if the emergency management and planning activities influenced community's and involved actors' risk perception. Moreover, the connection between risk perception, risk awareness and willingness to act will be investigated. Finally, as for the risk governance category, the reconstruction of the connecting network will provide a synthetic framework of actors, territorial scales and temporal scales, in order to explicit competences, contradictions and overlaps of the risk governance system.

Third and last section of the dissertation, *PART III. Planning effectively for Disaster Risk Reduction*, regards the elaboration of the results obtained by the analysis and the proposition of guiding areas of intervention and instruments that can help in the construction of the common foundations for an integrated approach in emergency and spatial planning.

The elaboration of the collected data is performed through the construction of

a relational database[1], that enhancing the model of the disaster cycle, systematize the processes of Disaster Risk Reduction, making explicit the connections between stakeholders, actions, data and time. This operational tool makes explicit the moment in which the continuity of the disaster cycle is interrupted, as well as the possible communication coupling among the different phases. In order to overcome the limitation imposed by technical tools, the final part of the dissertation proposes shifting from the instrument of the Civil Protection plan to the one of the strategic Civil Protection Programme.

The research design, characterized by a circular trajectory, has undergone substantial transformation with the beginning of fieldwork. Given the highly operational nature of the research topic and case study, i.e. emergency planning and Civil Protection, the fieldwork assumes a central role in influencing not only the study trajectory but also the critical categories outlined in the theoretical framework.

As already mentioned above, the discussion on the topic is carried on with the help of some specific case - studies, which are considered to be useful for drawing general conclusion that go beyond the specific event analysed (Flick, 2011). The analysed activities were chosen because they are relevant and representative of key moments for describing a bounded system[2] like that of Civil Protection. Through the detailed analysis of specific areas, like the one of the exercise or the participatory project, it is easier to approach such a complex system. A more in-depth description of the motivation for the selection of the two Civil Protection activities analysed will be given in the dedicated section (*Part II. Case study analysis: the Italian Civil Protection System*).

Comparison is not the objective of the analysis of the two activities. On the contrary, the combination of the two experiences results in the creation of context-dependent knowledge (Neuvel & Brink, 2010) to which the critical categories identified with the theoretical framework were applied.

Data collection is made through qualitative methodologies, using instruments such as direct observation, informal and semi-structured interviews, as well as analysis of documentation and critical review of plans and norms related to the subject.

Both"*Exe Sisma dello Stretto*" and the participatory planning in Bagnara Calabra were object of attentive observation and offered the possibility to participate to a wide selection of activities of the Civil Protection Department. As for the exercise, it was possible to participate as observer to many of the preliminary meeting of the different stakeholders involved, as well as to have access to the preparatory documents and evaluation reports (Annex II - Table 8). Together with the preparation phase,

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1 For a more in-depth analysis of the methodology used in constructing the relational database, please refer to Annex I.

2 According to Vanderstoep and Johnston (2009; pag.209) the focus of investigation of research that use the case study method is a bounded system, a "*specific, complex, functioning thing,"*. According to the authors, this system can be for instance an organization, a corporation, an ongoing support group and can be bounded in space, time or purpose. Therefore, for its characteristics, Civil Protection appears to be a suitable system for the analysis with such a methodology.

the most interesting activity observed was the execution of the exercise itself. There was the possibility to observe both field and coordination activities, thanks to the access to the DICOMAC structure[3]. Regarding the participatory process in Bagnara Calabra, observation concerned several meetings between the local administration and the different stakeholder involved (Department of Civil Protection, Regional Civil Protection, *Fondazione CIMA, Labsus - Laboratorio per la sussidiarietà,* civic groups…), as well as training days and assembly with the community.

In all the different meetings attended there was artificial immersion, since my role as researcher has always been declared (Vanderstoep and Johnston, 2009). Copious field notes were taken during the whole process. The observation activities happened both online and in presence, depending on the means through which the meeting was being conducted.

Together with direct observation, another relevant source of data collection were the interviews (Annex II - Table 7). Interviews were both informal and semi-structured. Some of them have been recorded and translated, while others happened in moments when recording was not possible, as for instance during the course of activities in the exercise days. People to be interviewed were selected taking into consideration their role and position in the different activities involved, trying to include actors from different territorial levels and responsibilities. Staring from a first selection of respondents, the group has subsequently been enlarged using snowball method.

Interviews touched different topics and questions, depending on the role of the people interviewed and on the specific activity they were involved.

As for the exercise "*EXE Sisma dello Stretto*", interviews were taken during the preparation phase, in the days of the exercise and after the end of the exercise. Respondents were members of Civil Protection Departments as well as officers of the Regional Civil Protection who took part in the exercise. Topic addressed regarded the preparation, execution and evaluation of the "*Exe Sisma dello Stretto*", especially focusing on the relation between the exercise and the Civil Protection planning on a long-term perspective, on the connection between ordinary and emergency planning and on the use of geospatial information in the process of emergency management and planning.

For what concern the interviews related to the participatory process in Bagnara Calabra, they were taken along the whole execution of the project and involved mostly people from the local administration of Bagnara Calabra, including technical practitioners and political authorities, as well as representatives of the community. The topic addressed referred to consideration on the development of the process, criticalities experienced, change of opinions regarding risk-related topic and expectation on the long-term legacy of the project. Together with the interview, great importance for data collection were the meetings and the discussions with the practitioners of Fondazione CIMA, who led the participatory project. Their role and importance will be further discussed in the dedicated chapter.

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3 The DICOMAC is a strategic structure, which is activated just in case of disastrous event of regional or national relevance, whose scope is to coordinate emergency management activities having a direct connection with the local level. It is organized in Functions, according to the Augustus Method organizations. Its location must be defined by regional Civil Protection plans.

In conclusion of this methodology discussion, it is important to add a final reflection. Among the motivations that prompted me to analyse the work of Civil Protection, including ongoing activities, is the fact that during this period the Italian Civil Protection system is experiencing a phase of regulatory adjustment following the issuance of the Civil Protection Code in 2018 and the subsequent Plan Directive in 2021. As will be further explored in the dedicated chapter, these new regulations attempt to implement a profound reorganization of the Italian civil protection system, particularly by emphasizing the importance of planning tools and introducing innovative concepts such as the digital plan. From a methodological standpoint, it is thus highly interesting to observe the ongoing changes and to analyse the implementation of these innovations in the department's daily work. However, it is important to note that during this nearly two-year observation period, the work of the Civil Protection Department has continued, particularly regarding certain technical documents that were not initially available and that would have been important for the development of certain areas of the research (I refer, for example, to the National Catalog of Civil Protection Plans - *Catalogo Nazionale dei Piani di Protezione Civile* - published in February 2024, which contains operational guidelines for the standardization of spatial information in Civil Protection plans at the national level).

Furthermore, the study of an on-going process, moreover when it includes an institutional agency like the Civil Protection Department, involves dealing with timeframe which cannot be controlled. This is something which had deeply influence the development of the research, as there has been the need to look for the compatibility of the Ph.D timeframe with the one of the institutional bodies object of analysis.

1.4 Results and outcome of the research

The results obtained from the fieldwork have perfectly reflected the critical categories identified in the literature, providing empirical evidence of the theoretical framework.

Regarding the *EXE Sisma dello Stretto* exercise, the analysis of the structure and use of the SIT DPC – the Spatial Information System of the Civil Protection Department - highlighted that the use of a Spatial Data Infrastructure is still insufficient to fully overcome the gaps in risk knowledge creation and transfer, due to both technical and procedural reasons. The tool has not yet become part of the daily practice for many of the actors involved in emergency management, resulting in an underutilization of its potential. Regulatory innovations, particularly the reference to the digital plan in the new Civil Protection Code, demonstrate a clear intention to move towards a full digital transition, though this process remains in its early stages. Furthermore, the observation of procedures revealed that informal and professional knowledge still play a central role, highlighting both the importance - and the challenges - of human capital in knowledge transmission processes.

As for the participatory process in Bagnara Calabra, the mapping of the participating actors highlighted the complexity of the risk governance system, especially in cases where the entire range of territorial levels—from national to local—is involved. It emerged that the frequent overlap of competencies can lead to confusion in the division of responsibilities, and that clearly identifying the roles of each actor—both institutional and technical—can help establish effective communication channels that facilitate the exchange of both formal and informal knowledge between the parties. Moreover, the importance of the local level was underscored, not only for its direct responsibility in the Civil Protection plan but also for its central role in facilitating community participation. This participation proved to be effective in enhancing the community's capacity, as the population responded positively and proactively. Unfortunately, the response from the municipal administration was not as favorable.

On the contrary, it struggled to take responsibility for the plan, and this approach risks eroding trust in the institution, leading to the opposite outcome of what the participatory processes aim to achieve.

The observation of the practices and instruments of emergency management and planning implemented by the various actors involved in the process revealed their impossibility in initiating effective risk reduction interventions in spatial planning. This is partly due to the inability of Civil Protection practices to overcome the Disaster Risk Reduction gaps identified in the literature, as well as a failure to recognize the central role of territorial issues in emergency management and planning, and thus in DRR. Operational and procedural aspects form the core of the Civil Protection plan, while territorial considerations appear to be of secondary importance.

Despite this outcome, the significance of territorial issues still emerged. One of the most interesting outcomes of the participatory process was the community's attention to spatial aspects related to the Civil Protection plan, such as the location and adequacy of strategic areas. This demonstrates that spatial discourse can serve

as fertile ground for initiating dialogue between the various parties.

Considering these findings, the research proposes some guiding development areas that could help build a common foundation for an integrated approach to emergency and spatial planning.

First proposes an operational tool that, by adding depth to the disaster cycle model, could help systematize the connections between stakeholders, information, actions, timelines, and data. This would make it possible to identify when continuity in the disaster cycle is disrupted and how communication across different phases could be better coordinated.

Additionally, to address the limitations of the current tool, the research suggests a shift from Civil Protection plans to a Civil Protection strategic program, partly following the trajectory of complex urban planning programs.

By integrating actions, tools, and actors into a single model, these proposals aim to address issues related to the DRR gaps, promoting the exchange of knowledge, tools, and practices across the various phases of the disaster cycle.

Part I

Disaster Risk Reduction.
A comprehensive framework

On April 3, 2024, at 8:00 AM local time, a magnitude 7.4 earthquake struck Taiwan. This main shock was followed by approximately fifty aftershocks, with magnitudes ranging between 5 and 6. Videos of swaying skyscrapers quickly circulated on the web and social media. There were 8 fatalities, over 800 people injured, and 127 reported missing.

During the night between February 5th and 6th, 2023, a violent earthquake with a magnitude of 7.8 occurred in a region spanning Turkey and Syria, followed by dozens of aftershocks. According to estimates from the two affected countries, the event resulted in over 57,000 fatalities, more than 121,000 injured, and a significant number of displaced people and material damage.

On August 26, 2016, a magnitude 6.0 earthquake struck central Italy, marking the beginning of a seismic swarm that lasted a year, which the INGV - *Istituto Nazionale di Geofisica e Vulcanologia* (National Institute Of Geophysics And Vucanology) defined as the Amatrice-Norcia-Visso seismic sequence. Overall, this prolonged series of shocks caused over 41,000 displaced people, 388 injured, and 303 deaths.

Can those events be considered all the same?
Do differences among them exist?
Can they all be considered *disasters*?

It could be argued that an event becomes a disaster when the limit of governability of the system within the event is displaying is overtaking, when there is a failure of the condition for self-sufficiency. Disasters happen when the demands created by physical events surpass the ability of social systems and institutions to respond (Drabek, 1970; Tierney, 2012; Bertin, 2018).

Figure 3 well explains the concept. The disaster happens when the threshold between sufficiency and non-sufficiency is overcome. The definition of this threshold is not straightforward, as it implies the knowledge of the contextual elements of the

place where the event happens. Furthermore, this threshold is influenced by different factors, some of which can push the limit up, increasing the disaster management ability of the system, while others can move the limit down, creating the condition for failure.

The ability to manage this balance is rooted in the understanding of disaster risk, which in fact is the first Priority for Action of the SDFRR - Sendai Framework for Disaster Risk Reduction (UNDRR, 2015), the United Nations international agreement on the topic of Disaster Risk Reduction. In the SDFRR (UNDRR, 2015, p.14) it is written that:

"Policies and practices for disaster risk management should be based on an understanding of disaster risk in all its dimensions of vulnerability, capacity, exposure of persons and assets, hazard characteristics and the environment. Such knowledge can be leveraged for the purpose of pre-disaster risk assessment, for prevention and mitigation and for the development and implementation of appropriate preparedness and effective response to disasters."

Therefore, understanding disaster risk is the objective of this part.

Chapter 2 - Understanding Disaster Risk will give a comprehensive definition of the main elements that characterize disaster risk, trying to highlight their significance in relation to the needs of the present work, while Chapter 3 - Gaps in Disaster Risk Reduction will focus on the description and analysis of the critical categories of DRR Gaps that will be central for the analysis of the case studies, i.e. Risk Assessment, Risk Knowledge creation and transfer, Risk Awareness and Risk Governance.

The scope of the following pages is to establish common understanding of the terminology and of the context that represents the backbone of this investigation, while highlighting the complexity and uncertainty that define the field.

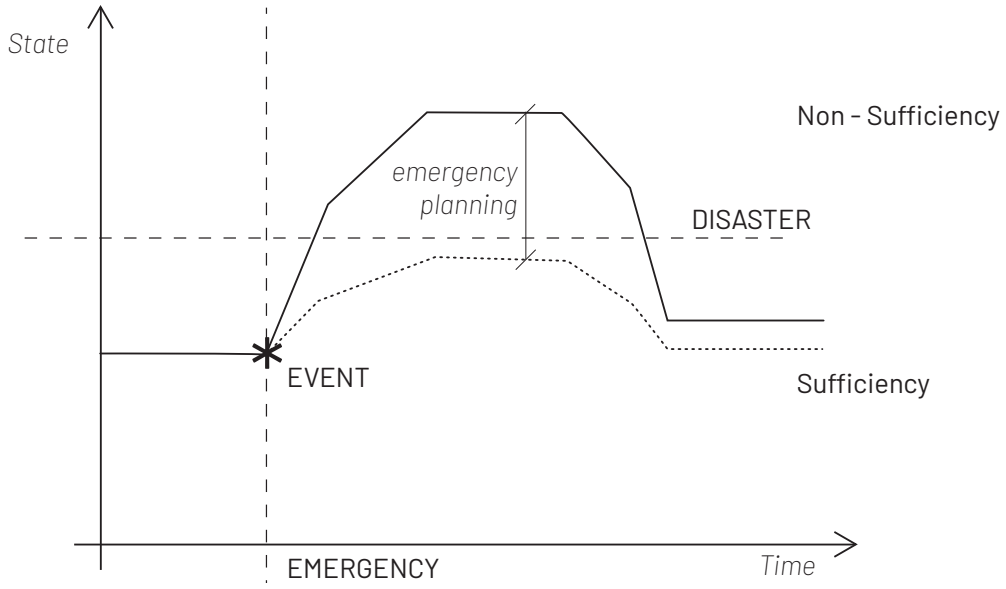

Figure 3. The Evolution of the event into a disaster.
Source: Author's elaboration based on Bertin, Aquilue, Ruiz, 2017

2 | Understanding Disaster Risk

2.1 Risk and Disaster, some definitions

Two of the fundamental pillars of the wide field of Disaster Risk Reduction are – of course – risk and disaster. Those two terms might sometimes be used interchangeably, while more often are coupled, even though their meanings are not the same. The same Sendai Framework Terminology on Disaster Risk Reduction gives a separate definition for the term "*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"

while pairing "*Disaster Risk*":

"The potential loss of life, injury, or destroyed or damaged assets which could occur to a system, society or a community in a specific period of time, determined probabilistically as a function of hazard, exposure, vulnerability and capacity".

What becomes evident in the two definitions, and probably represents the essence of the difference between the two terms, is that while risk implies the possibility of occurrence (*"the potential loss of life…")*, disaster is a state (*"A serious disruption of the functioning of a community or a society"*).

The same concept was somehow anticipated in the introduction to this chapter: disaster represents the exceeding of a threshold of sufficiency, while risk "assesses" (later we will understand specifically what this assessment implies and means) the possibility that this threshold will be reached and surpassed.

An interesting nuance that distinguishes the concept of risk from that of disaster involves a certain degree of uncertainty associated with the former, which implies both the possibility of losses and positive outcomes. Risk is a combination of complexity, uncertainty and ambiguity (Renn, 2009). Because of this, when dealing with risk, great effort is put on risk assessment and risk management, to reduce the probability of losses (Roeser et a, 2012; Tierney, 2018).

The conception of risk implies the possibility for action to (Disaster) Risk Reduction, while only dealing with disaster set the goal on management.

How to act for disaster management and risk reduction, depends on the

characteristics of the event we are facing, as well as through the lens that we use to read the phenomena.

As for the notion of disaster, its significance has evolved with time, reflecting as well changes in the disciplines dealing with the topic. The first ancient and fatalistic approach to disasters considered them as "*Acts of God*", hence not encouraging the development of arrangements to deal with them, for the inner characteristic of such a transcendent definition (Quarantelli, 2000).

With the development of science, the obtained knowledge contributed to the shaping of a new conception of disaster, seeing them as "*Acts of Nature*". In this framework, disaster still cannot be eliminated or prevented, but the understanding of what was supposedly involved might help in acting against them, weakening their impact.

Another major shift happened when disaster started to be seen as "*Acts of Men and Women*" and therefore "*Acts of Society*". If people are living in non-earthquake proof building in known seismic zone, or if they are staying in unprotected flood plains, they are creating the conditions for a disaster to happen (Quarantelli, 2000).

This transformation in the concept of disaster is interesting not only for the understanding of the act itself, but also because different visions on the element leads to different approaches in facing them. If disasters are "Acts of God", then it is proper to have a fatalistic approach. On the contrary, if disasters are "Act of Nature", there might be the need to attempt engineering solutions to tackle the problem. Finally, when disasters are "Acts of society", taking social action to avoid them is the path to follow (Quarantelli, 2000).

Regarding the concept of risk, in the field of DRR, it is usually defined as the non-linear function of hazard, vulnerability and exposure. More recent definition of risk, as for instance the one given above from the Sendai Framework terminology, also include the element of capacity. Risk is often quantified as the expected damage, intended for example as economic value or number of buildings, or loss, with reference to fatalities (Varnes, 1984; Menoni, 1997).

$$R = f(H,E,V,C)$$

R= Risk
H= Hazard
E= Exposure
V= Vulnerability
C= Capacity

Extended definition of hazard, exposure, vulnerability and capacity – especially for the latter two– might slightly vary from discipline to discipline. However, to promote the common understanding and usage of the concepts, it might be useful to start once again from the official terminology given by the Sendai Framework.

According to this document, hazard is defined as

"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. […] Hazards may be single, sequential or combined in their origin and effects. Each hazard is characterized by its location, intensity or magnitude, frequency and probability.".

Earthquake, flood, soil degradation, toxic spilling and fires are all examples of hazards. Moreover, Hazard itself is the function of four variables: intensity, intended as the severity of the expected event; location, intended as the spatial distribution of the event; and finally, frequency and probability, related to the temporality of the event.

The second variable of the risk function is exposure, described as

"*the situation of people, infrastructure, housing, production capacities and other tangible human assets located in hazard-prone areas".*

Exposure deals with the quantity and the quality of the element or systems located in the area affected by the hazard. While the definition of *quantity* might appear of easy interpretation, it represents the "number" of assets or activity exposed to the hazard, the one of *quality* introduce an element of complexity, as it usually refers to the functionality of the element or the economic value. Some examples could be the value of certain crops in an agricultural area or the historical-artistic value of cultural heritage, or the strategic importance of an infrastructure.

Although in some cases the evaluation of the exposure might seems straightforward, i.e. in the case of the economic value, in other the situation is way more complex. For instance, which is the measurement unit for evaluating cultural heritage? How do you evaluate the strategic importance of an infrastructure? If the discourse is expanded to more complex system, as for instance urban ones, the evaluation becomes even more challenging, since heterogeneous elements and their interactions need to be included in the discourse. In this regard, some studies propose a classification of urban exposure into "types" of exposure, based on the role that a specific element plays within the unified urban system: physical exposure, understood as the quantitative component of the exposed assets, and functional or systemic exposure, relating to the relationships and the role of the element within the overall system (Cremonini, 1994; Galderisi et al 2007). However, even with this typological definition, the matter of countability of the exposure remains.

We will see in the following chapter (*Chapter 4. Structural Gaps in Disaster Risk Reduction*) how the problem of unified definition and quantification of the elements that compose risk in central and unsolved, especially in the case of complex system and cascading events.

Third element of the risk function is vulnerability. UNDRR defines Vulnerability as

"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 hazard".

The concept of vulnerability is probably one of the most arduous as encompasses a variety of elements, including sensitivity or susceptibility to harm

and lack of capacity to cope and adapt. As remarked by Cutter (2013) understanding vulnerability *"is critical, as localities and nations cannot develop DRR strategies in the absence of knowing who and what is most vulnerable"*.

Vulnerability is a multi-faced concept, which can involve a variety of dimensions (Limongi and Galderisi, 2021):

- *Physical or structural vulnerability* is usually connected to engineering disciplines and refers to the robustness of physical assets (i.e. buildings, infrastructures…);
- *Environmental and ecological vulnerability*, which is mostly studied in respect to climate-related events;
- *Social vulnerability* often studied as complementary to the structural one. Many different indexes have been developed to study this phenomenon, among which one of the main reference is the Social Vulnerability Index (SoVI), introduced in the early 2000 and still one of the most used (Cutter, 2013). It refers to the susceptibility of a social group to the adverse impacts on hazards. Usually, this dimension of vulnerability is intended for individuals or communities, but it might also include institutions;
- *Economic or socio-economic vulnerability*;
- *Institutional vulnerability*, generally addressed to evaluate the ability of institutions (national, regional and local authorities) to cope with hazardous event. It is considered a key component in risk governance.

Furthermore, the complexity of the vulnerability aspects is not only given by the many typologies, but also by its systemic, dynamic and spatial characterization, which is particularly relevant especially if related to urban systems. The different aspects of vulnerability cannot in fact be analyzed only as singular and static, but, on the contrary, they need to be integrated in a model which considers as well nonlinear effects due to the – possible - growing fragility of the components. Hence, together with exposure, vulnerability poses the challenge of proper assessment.

Finally, a concept that is often introduces as complementary to vulnerability is the one of capacity. According to the Sendai Terminology, capacity is

"The combination of all the strengths, attributes and resources available within an organization, community or society to manage and reduce disaster risks and strengthen resilience. […]Capacity may include infrastructure, institutions, human knowledge and skills, and collective attributes such as social relationships, leadership and management".

Capacity refers to the ability of a system to respond and to recover from the effects of stress or perturbation that affect the system, to disturbance and potential damage, taking advantage of the opportunities and adapting to consequences. Usually, coping capacity is associated with extreme events, whereas adaptive capacity alludes to longer periods of time, where some learning is supposed to happen, either before, during or after the extreme event. For this characteristic, the concept of adaptive capacity is often associated with climate change related studies (Gallopin., 2006; Burkett, 2013).

Hence, vulnerability and capacity can be considered as negative and positive

elements of a system, connected by an inversely proportional relationship. Those two elements will be important later on in the investigation, as the idea of strengthening the coping capacity of a community, and therefore reducing social vulnerability, is central in participative approaches to Disaster Risk Reduction.

Understanding how hazard, exposure, vulnerability and capacity influence risk is central for defining effective Disaster Risk Reduction actions, as each action will be specific to one – or more – of those elements. For example, seismic retrofitting will reduce structural vulnerability, while the relocation of a certain facility might reduce the exposure of a system. And again, informing a community on how to act in case of a certain calamitous event will raise their coping capacity, while the construction of a retaining basins can lower the hazard level of a flood-prone area.

While it is always possible to lower the levels of exposure and vulnerability, or raise capacity, the same discourse cannot be done with hazard. Our possibility to reduce the level of hazard is strictly connected to the nature of the event. It is possible to secure a landslide, but we are helpless in front of an earthquake.

This differentiation has characterized the early period of Disaster Risk Reduction disciplines, which used to classify risk and disaster as natural or anthropic. However, while this binary distinction might, in some cases, be appropriate for the definition of certain types of hazards (an earthquake or a volcanic eruption are natural hazards, while the explosion of an industry is an anthropic one), it would be incorrect to label just as "natural" or "anthropic" risk or disaster, as we saw in the previous lines that they are always the results of the interaction of various elements, of whom hazard is just one of them. This hazard-driven view has been criticized by different scholars starting from the 70s, leading to the modern consideration on risk, seen as a holistic concept that integrates environmental, social, economic, political, infrastructural and governance-related drivers[1].

However, understanding the level of "naturalness" of the triggering hazard might as well give an insight about the methods for reducing disaster risk. In this regard, an interesting characterization is given by Tira (1997;2022) who classifies disasters into three different categories:

1. *Passive physical events*, which cause is structurally natural, and it is impossible to predict the occurrence. In this case, activities must be focused on prevention, targeting the reduction of vulnerability and exposure of the affected elements. A classic example of this events are seismic ones.
2. *Intermediate events*, where the cause is both natural and anthropic. In this case, risk reduction measures still must be focused on prevention, reducing vulnerability and exposure, but hazard can also be mitigated to a certain extent, at least reducing the intensity. An example of this type of event could be related to landslides, whose level of hazard can be significantly reduced through monitoring (thereby allowing intervention in the preparedness for the event) or the implementation of structural measures, such as the

1 The wide debate about the "naturalness" of risk and disasters has been addresses by different scholars in different disciplines. A valid synthesis of the evolution of the modern concept is given by Ishiwatari et al 2020

construction of containment structures.

3. <u>*Man-made events*</u>, where the natural components might influence the level of damage, but the occurrence is totally anthropic. A typical example of this is transportation accident, where the combination of human behavior, technical failure (i.e. engine or breaks rupture) and the environment (i.e. road conditions, heavy rains) leads to a possible event. This is a case in which hazard can be significantly reduced.

Apart from the terminology election[2], what is interesting in Tira's classification is the connection between level of naturalness of the triggering hazard, variables of the risk function addressed and moment of intervention.

When the cause of disaster risk is structurally natural, activities must be focused on prevention, targeting vulnerability, exposure (and capacity). If the level of anthropization grows, triggering hazards can be addressed, moving the actions as well in the preparedness phase.

In conclusion, one last classification of disasters which is interesting to mention is the one given by the same *Sendai Framework terminology* (2017), which categorize disaster based on spatial scale and temporal scale. According to the spatial one, there can be small-scale disasters – only affecting local communities, which require assistance beyond the affected community – and large-scale disasters - affecting a society which requires national or international assistance[3]. As for the temporal scale, four are the possible classifications: a) frequent and infrequent disasters, which depend on the probability of occurrence and the return period of a given hazard and its impact, impact that can be cumulative or become chronic; b) slow-onset disaster, defined as those emerging gradually over time, as for instance drought, desertification or sea-level rise; and finally, c) sudden-onset disasters, intended as the ones triggered by hazardous events that emerge quickly and unexpectedly, as earthquakes or chemical explosion.

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2 Changing the term "passive physical event" with "natural event", Tira's classification appears very similar to the mainstream definition of natural and man-made disaster. However, the point of this question is not to define the differences in terminology, nor to provide a comprehensive description of natural and man-made disasters, deepening the topic is not the focus of this work, while Tira's classification is useful for wider discourse he starts.

3 This kind of categorization is interesting because is similar to the one used by the Italian Civil Protection for the definition of the appropriate territorial level in charge of emergency management (local, regional or national) in case of disastrous event. This topic will be further investigated and explain in *Part II – Chapter 4 The Italian Civil Protection System*.

2.2 The disaster cycle

One of the models that is most often used for the characterization of disaster risk management is the one of the so-called "disaster cycle". This model considers disasters as cyclical events, which form a cycle that can be dived into different phases, encompassing actions from prevention to recovery, organized around the happening of the disastrous event (Figure 4).

While there is no agreement among scholars about the origin of this model (Bosher et al., 2021), its diffusion is undeniable, not only in the field of academic disaster studies, but also as operative framework for relevant disaster management organization as for instance FEMA – Federal Emergency Management Agency, the USA governmental office for emergency management, DG ECHO - European Civil Protection and Humanitarian Aid Operations (DG ECHO, 2021) and the same Italian Civil Protection (Dolce et al., 2020).

According to Alexander (2002), four are the phases of the disaster cycle: *mitigation, preparedness, response* and *recovery*. Mitigation and preparedness are the phases that come before the disastrous event, while response and recovery belong to the aftermath. The actions taken, and consequently the planning procedures that dictate them, vary for each period, addressing distinct needs.

Before the event

Mitigation refers to the group of actions designed to reduce the impact of future disasters. It usually refers to the sphere of actions aimed at the lessening of the impact of hazards[1], through structural and non-structural intervention. Structural interventions are defined as the engineering solutions to the problem of safety, which usually concern improving the structural strength of buildings, constructing embankments or retention basins or securing landslide slopes. On the contrary, non-structural interventions concern the group of actions focused on the modification of human and social behaviors, through regulatory measures, community awareness and education, warning systems and environmental policies (Alexander 2002; Coppola, 2015; Bosher and Chmutina, 2017; UNDRR 2017[2]).

Preparedness involves actions taken to reduce the impact of disasters when they are forecast or imminent, using knowledge and capacities developed by governments, response and recovery organizations, communities and individuals. This phase is based on a sound analysis of disaster risks and good linkages with early warning systems and includes such activities as emergency planning, the stockpiling of equipment and supplies, the development of arrangements for coordination, evacuation and public information, and associated training and field exercises (Alexander 2002; Coppola, 2015; UNDRR 2017).

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1 The term mitigation is mostly used in some specific context of DRR associated to spatial planning, while in the Climate change policies is mostly associated with the reduction of greenhouse gas emissions (UNDRR, 2017). Adaptation and prevention are most often used in the context of resilience and climate change related planning. For the purpose of this paragraph, the difference between the use and meaning of the two terms is not relevant.

2 The DRR glossary - UNDRR – United Nation Office for Disaster Risk Reduction https://www.undrr.org/drr-glossary/terminology. Last Accessed: 15/05/2024

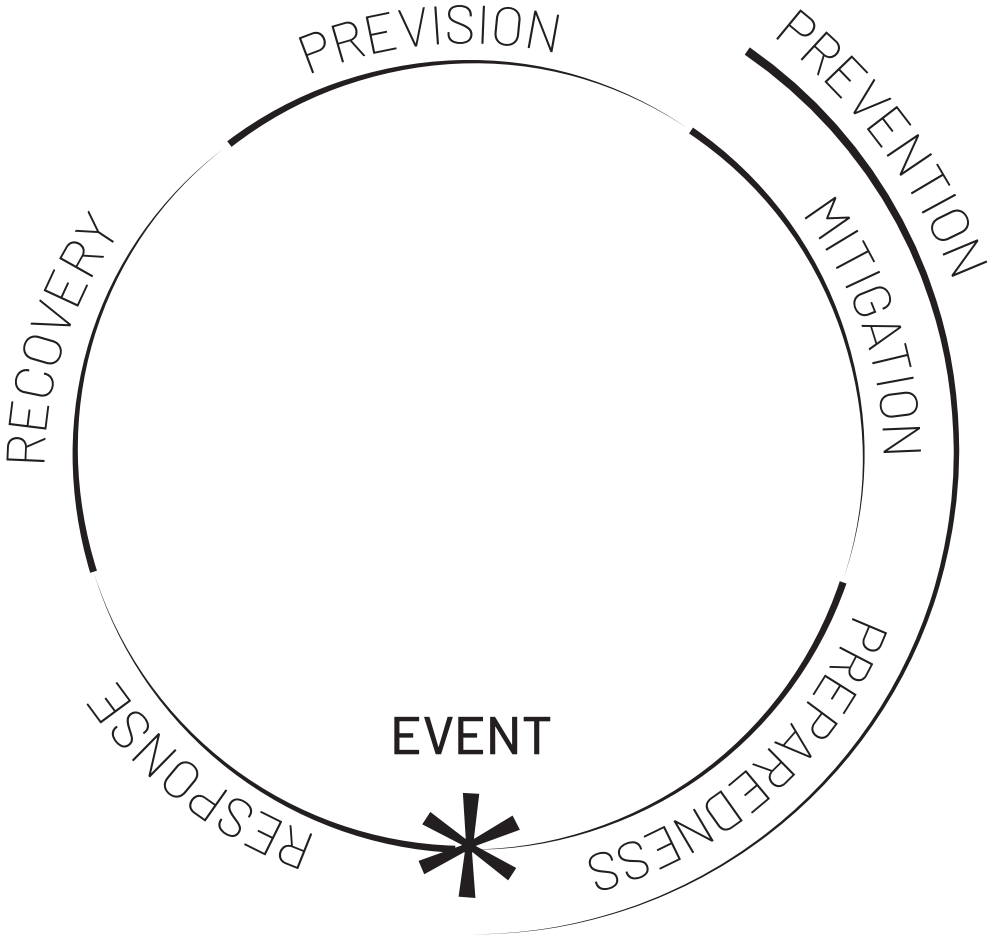


Figure 4. The disaster cycle
Source: Author's elaboration based on Alexander 2002 and Smith 2009

Smith (2009) operates a different classification of the phases that come before the disastrous event, dividing them in Prevision and Prevention.

Prevision involves actions for risk assessment and construction of risk scenario, including vulnerability and exposure evaluation. It implicates data collection and processing, determining the likelihood and consequences of each risk.

Prevention would be the merge of mitigation and preparedness phases of Alexander's model. It includes mitigation actions, preparedness activities, and the development of emergency plans.

Apart from the differences in terminology, the inclusion of the prevision phase adds and important layer to the risk management process as it makes explicit the function of risk assessment and risk knowledge, two relevant issues of the wider Disaster Risk Reduction discourse.

After the event

Response deals with actions taken during or immediately after the disastrous event, in order to save lives, reduce health impact, ensure public safety and meet the basic needs of the population involved. Actions taken during the response phase are highly dependent on the magnitude of the event, as well as on the level of preparedness of the affected community or system. Response often includes the provision of emergency services and public assistance, made by public and private stakeholders, such as for instance Civil Protection, police and fire services.

Recovery is the process restoring economic, physical, social, cultural and environmental assets, system and activities of a disaster-affected community of society. It is generally used to roughly indicate the wider post-disaster response, which include all the actions that happens after the crisis time, to restore balance. Not only physical activities are considered in this phase, but also other kinds of intervention such as phsycological counselling (Quarantelli 1999, Alexander, 2002, UNDRR 2017).

There is no clear-cut division between the response and the recovery phases. In the contrary, activities of one phase might easily overlap the other, i.e. some response actions, such as the supply of temporary housing and water supplies, may extend well into the recovery stage (Galderisi et al, 2022).

Although there are minor differences in terminology, the model described here is one of the most widely used. However, the disaster cycle model is not universally accepted, with many authors considering it outdated, overly rigid, and thus inadequate for representing the complexity of disasters. In an insightful paper, Bosher et al. (2021) outline several key requirements for a new model that addresses the limitations of Alexander's model:

1. *Move away from a closed loop:* Typically, the disaster cycle is depicted as a closed loop, perpetually cycling through various disaster phases. This representation should be open-ended to allow for the possibility of progressing towards a future without further disasters.

2. *Avoid making the disaster event a key component*: Most current models are biased towards emergency management activities, focusing on responding to or preparing for disaster events. This implies that a disaster is necessary to trigger risk reduction activities.

3. *Consider more than the temporal scale:* The traditional model only considers the temporal aspect without providing insight into the proportion of resources required for each phase or defining the duration of each phase.

4. *Address systemic events*: The linear representation of the disaster cycle fails to capture the complexity of systemic events.

The authors of the study propose the "disaster helix" model as a solution to their concerns with the circular model. The disaster management helix would emphasize the dynamic, non-linear, and continuous nature of managing disasters, incorporating proactive risk reduction, disaster response, and recovery activities that aim to reduce the impact of subsequent disasters over time. This model contrasts with the traditional cyclical view, offering a more realistic representation of the complex, uneven, and multi-scalar interactions in DRM, and underscores the potential for terminating or reducing disaster risk through sustained and adaptive efforts (Figure 5).

Apart from the speculation on the geometrical definition of such model - both the disaster cycle and disaster helix are overly simplistic frameworks, it is evident that these models must be further refined and made more complex to adequately address the demands of effective disaster risk reduction - two of the points highlighted are of particular interest for the present research, as they tackle some issues that will be central further on: the centrality of the calamitous event in relation to disaster management models and the need for a sharp complexification of the models, which make it multi-scalar and multi-actor.

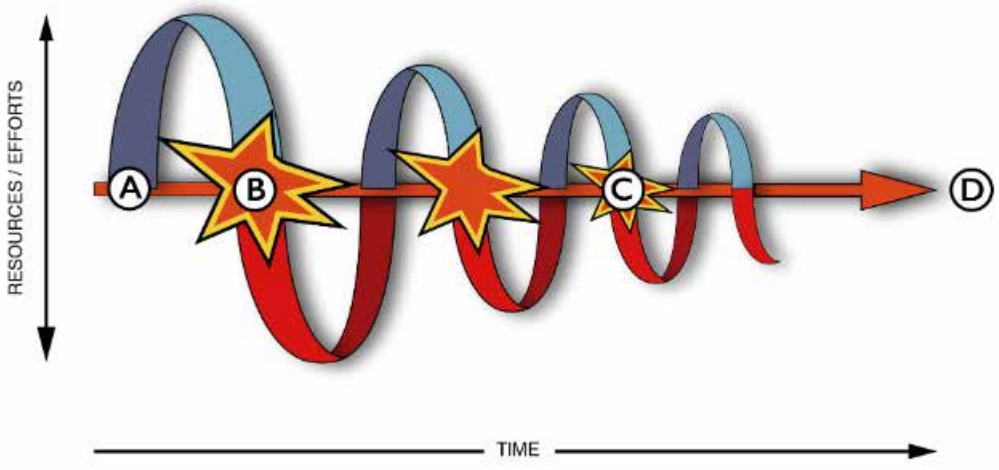


Figure 5. The disaster helix
Source: Bosher et al 2021

2.3 Practices and actions for reducing risk

As in the previous paragraph, for a first general definition of the concept of Disaster Risk Reduction it might be useful to start from the one given by the Sendai Framework Terminology on DRR:

"Disaster risk reduction is aimed at preventing new and reducing existing disaster risk and managing residual risk, all of which contribute to strengthening resilience and therefore to the achievement of sustainable development. Disaster risk reduction is the policy objective of disaster risk management, and its goals and objectives are defined in disaster risk reduction strategies and plans."

Disaster Risk Reduction (DRR) can therefore be considered as the group of actions that focus on preventing the emergence of new disaster risks, diminishing existing risks, and managing any remaining risks, through the definition of comprehensive, multi-disciplinary and multi-actor strategies and plans.

Effective DRR strategies are the ones that manage to reduce the levels of hazard, exposure and vulnerability, or increase the capacity, of a certain system affected by risk. Actions of DRR comprehends a wide range of disciplines, including for example engineering, environmental science or social sciences. They require the collaboration of diverse actors, ranging from local communities and non-governmental organizations to government agencies and international bodies. As disasters manifest from the complex interplay of a variety of diverse factors, interventions must address each aspect comprehensively.

The UNDRR - United Nations Office for Disaster Risk Reduction makes a first interesting differentiation of DRR actions, based on the specific stage of intervention:

Prospective actions aim to preemptively tackle the emergence of new or increasing disaster risks. This approach emphasizes the importance of implementing policies that will prevent future vulnerabilities, as for instance proper land-use planning or the construction of disaster-resistant water supply systems.

Corrective actions concentrate on existing disaster risks that require immediate attention and mitigation. This approach involves direct actions to manage and reduce current vulnerabilities. Examples include the retrofitting of critical infrastructure to withstand potential disasters (reducing structural vulnerability) and the strategic relocation of populations or assets from high-risk areas (reducing exposure of the population of assets).

Compensatory actions are designed to enhance the social and economic resilience of communities against residual risks that cannot be entirely eliminated. This encompasses preparedness, response, and recovery activities, supplemented by various financial instruments. Examples of these instruments include national contingency funds, contingent credit lines, insurance and reinsurance schemes, and social safety nets. Collectively, these measures ensure that societies are better equipped to cope with and recover from the impacts of disasters, therefore increasing

capacity.

Another typical differentiation for Disaster Risk Reduction measure is the one between “Structural measures” and “non-structural measures”

Structural measures refer to physical constructions or the application of engineering and technological methods designed to minimize or prevent the impacts of hazards. These measures enhance the resistance of infrastructure and systems to potential disasters. Examples of structural interventions include the construction of dams and flood levies to manage water flow, ocean wave barriers to protect coastal areas, earthquake-resistant buildings to withstand seismic activity, and evacuation shelters to provide safe havens during emergencies.

Non-structural measures, conversely, do not involve physical constructions but instead rely on knowledge, practices, and regulatory frameworks to mitigate disaster risks and their effects. These measures are implemented through policies, laws, and educational initiatives aimed at fostering awareness and preparedness among the public. Typical non-structural strategies include the development and enforcement of building codes to ensure safe construction practices, land-use planning laws to regulate development in vulnerable areas, and public awareness programs that educate communities on disaster preparedness and response. Additionally, research and assessment efforts play a crucial role in informing and guiding these non-structural measures.

Community engagement as compensatory non-structural measure for Disaster Risk Reduction

For decades, top-down approaches to Disaster Risk Reduction have been the cornerstone for addressing the impacts of natural hazards. These approaches are typically executed by government organizations with specialized technical capabilities and a centralized, hierarchical management structure. Such models rely heavily on a “command and control” methodology (Quarantelli, 2000; Alexander, 2002), where decisions are made by authorities and then implemented through a structured chain of command.

However, the last few decades have witnessed significant shifts in the landscape of DRR and these evolving conditions have prompted a reevaluation of the conventional top-down approaches and spurred discussions on the need for more proactive and participatory strategies. In response to these changes, there has been a gradual shift towards more people centered approaches, emphasizing stakeholders’ participation, greater transparency, and the redistribution of responsibility from authorities to the public.

Community inclusion in DRR practices is now recognized not only as an effective strategy for building resilient communities but also as a necessary practice for preparing the population for emergency situations to mitigate damages and losses (Claassen et al., 2020). This is evident also in some norms and regulation both at international and national level. As it will be seen later on in this work, this is for example the case of the new Italian Civil Protection Code, that included participatory processes as a mandatory activity during the drafting of Civil Protection plans.

An aware and active community proves to be an effective risk reduction tool at every stage of the disaster cycle. Facilitating a community's engagement in a process of conscious participation helps to overcome the issue of the weak relationship between risk perception and the implementation of preparedness and mitigation measures. Through participatory processes involving communication, joint efforts, and the exchange of experiences, it is possible to make the population aware of the risk conditions affecting their area, conscious of their personal and collective responsibilities, and equipped with the necessary tools for preparation and appropriate behavior in emergencies (Wachinger et al., 2013).

Community involvement and participatory processes can be top- down or bottom-up. In the first scenario, public institutions are the ones initiating the projects, while in the second scenario, the initiative can come from citizen associations or various types of groups, which may be more or less organized.

According to Scolobig et al (2015), participatory approach is characterized by the active involvement of stakeholders in decision-making processes. This includes engaging local communities, non-governmental organizations, private sector entities, and other relevant actors in the design and implementation of risk mitigation strategies, emergency plans, and early warning systems. By involving those who are directly affected by disasters, authorities can ensure that risk reduction measures are tailored to the specific needs and capacities of different communities.

Effective participatory approaches involve effective communication, crucial for building trust between authorities and the public (Albris et al., 2020).

Despite the clear benefits, implementing participatory approaches is not without challenges. Participatory approaches highlight that effective Disaster Risk Reduction should be rooted not only in solid scientific and technical foundations but also in the robust development of institutional capacities. While it is true that other factors, such as insufficient resources or lack of support, often significantly influence outcomes, the emphasis on building institutional capacity remains central in participatory strategies. Deficiencies in this area can often be traced back to issues such as poor coordination and collaboration among various agencies, a lack of strong political commitment, inadequate legislative frameworks, or ineffective implementation of established norms. One significant issue is the allocation of responsibility between authorities and the public. Authorities must provide adequate resources, education, and support to empower communities. Simultaneously, there needs to be a concerted effort to build trust and ensure that the public understands and values their role. As it will be clear with the analysis of one of the two case studies selected, without strong political support and appropriate legal frameworks, participation in DRR initiatives may struggle to achieve their objectives (Kuhlicke et al 2011; Oxley, 2013; Scolobig et al 2015).

2.4 Spatial Planning for Disaster Risk Reduction

Spatial planning and Disaster Risk Reduction are intrinsically interconnected, being risk is a socially constructed phenomenon, impacting complex systems. Consequently, cities and territories cannot be excluded from this discourse. Both the Hyogo Framework for Action 2005-2015 (UNISDR, 2005) and the Sendai Framework for Disaster Risk Reduction (UNDRR, 2015) highlight the need for spatial planning to be integrated to DRR. The relationship between risk and spatial planning is reciprocal: on one hand, catastrophic events can impede or disrupt urban development, as evidenced by major earthquakes such as the 1908 Messina earthquake or the 1968 Belice earthquake, which significantly altered the development trajectories of those areas. On the other hand, urban and territorial development can alter the hazardous characteristics of a region, increase the vulnerability of an area, or raise the exposure of a given population, therefore lifting risk level (Menoni, 1997) (Figure 1).

The topic of seeking conceptual understanding and practical method for integration is highly debated, as it is the necessity to define context-specific arrangements, in parallel with general frameworks of action and governance.

2.4.1 Spatial Planning and resilience

One of the concepts that is most associated with risk and spatial planning, especially when dealing with urban systems, is that of resilience. The concept of resilience has introduced a significant issue in different semantic areas and resilience theory, particularly social-ecological resilience, has influenced urban planning and strategic development, emphasizing its importance in managing uncertainties and complexities in urban systems. For the purpose of the present research, some general insights into this wide concept will be provided, in order to delineate the broad boundaries of the discipline in relation to Disaster Risk Reduction.

The concept of resilience, originally rooted in ecological studies, describes how systems withstand and adapt to external stresses and disturbances. Resilience theory underscores the importance of non-linear dynamics in maintaining system stability amidst changes (Holling, 1973). In ecology, resilience emphasizes a system's ability to persist and adapt rather than merely return to a pre-disturbance state, a notion known as ecological resilience (Adger, 2000; Holling, 1996; Walker et al., 2004).

Holling differentiated between stability (returning to equilibrium after a disturbance) and resilience, which involves adapting and continuing to function despite changes. This distinction led to two resilience perspectives: engineering resilience, which focuses on the system's ability to quickly return to a steady state, and ecological resilience, which highlights the system's capacity to adapt to changes and maintain multiple equilibria (Davoudi et al., 2012; Folke, 2006).

Engineering resilience is concerned with linear systems where recovery from disturbances is predictable, measured by how swiftly the system returns to its

original state (Adger, 2000; Coaffee et al., 2009). However, ecological resilience applies to complex systems with non-linear interactions, where disturbances can lead to unpredictable changes and self-organization. These systems don't return to a previous state but evolve continuously, adapting to new conditions. This means understanding how ecosystems are structured and function, and how institutions and their associated individuals are organized and operate. (Folke, 2006; Bertuglia & Staricco, 2000).

The application of resilience theory extends beyond ecology into fields dealing with complex systems and non-linear dynamics, including social sciences and urban planning (Folke, 2006).

Resilience and its interactions across different scales play a crucial role in facilitating a transition towards more sustainable development. Several scholars (Gunderson & Holling, 2002; Lambin, 2005) have highlighted that the systemic orientation of resilience is pivotal for sustainability. In an environment characterized by uncertainty and unpredictability, adopting a resilience perspective in examining social-ecological systems allows for the integration of diverse stakeholders—scientists, policymakers, practitioners, entrepreneurs, and citizens—whose collaborative interactions across scales shape system dynamics.

Therefore, resilience signifies a shift in the approach to policy planning, governance, and coordination, offering a shared framework that bridges various sectors and disciplines. Indeed, the concept of resilience gained significant prominence in urban planning discourse about a decade ago, driven by the widespread crisis affecting territories, economies, societies, and consequently, the knowledge and practices applied to them. In this context, resilience should be understood as both a meaningful perspective and an approach, a method of intelligent, continuous, and non-linear adaptation to external conditions, which should inspire urban planning by overcoming sectoral divisions and narrow specializations (Gabellini, 2018).

An interesting example of resilience-planning framework is the one defined by Menoni (2020), which is explained in Table 1. While it must not be considered as exhaustive, the table provides a comprehensive vision of the planning instruments coherent with resilience and Disaster Risk Reduction perspective. According to the author, in fact, planners already have in their toolbox several instruments which are capable of activating risk reduction intervention on the territories.

Tool	Hazard	Exposure	Vulnerability	Resilience	Pros & Cons
Zoning Division in zones of the area, according to different urban function and land uses	New developments can create or worsen some hazards conditions	Acting on surface and volume standards, it can influence the occupacy, economic value, use...	Address systemic vulnerability with decision on public space location, infrastructure, transportation nodes.	Scenarios of optimal zoning in areas that are already urbanised can be identified for pre-event recovery plans	It might be useful in scenarios of re-developing, while it is too rigid to follow in the case of changing cities' dynamics
Standard subdivision Urban standards related to specifi feature of the urban design	New developments can create or worsen some hazards conditions	Key tool for addressing concentration of people and built up areas	Defining issues such as morphology, patterns and road network density etc such, standards can address both physical and systemic vulnerability	After a disaster, subdivision standards can be revised in an easier way and more accepted by owners	Being a tool that affect property rights, there might be the need to design them carefully and according to a participatory approach
Relocation Can be partial (relocation of a building) or total (urban settlement)		Reduce the exposure in a hazardous areas		By avoiding or reducing exposure in hazardous areas it reduces the amount/severity of damage thus will require less efforts in recovery	Effective but very costly both economically and socially
Structural mitigation measure consolidation of landslides, building retrofitting, nature-based solutions etc	Structural mitigation measures aim directly at hazard reduction, by lessening the impact of the event		Intervention on buildings and other structure can reduce structural vulnerability	Reducing the severity and extent of damage, permits a faster and less costly recovery	Structural measure might provide a false sense of security and encourage development in highly hazardous zones.

Table 1. Framework of tools for resilience-planning
Source: Author's elaboration based on Menoni 2020

2.4.2 Spatial Planning and Emergency Planning

The previous paragraph delineated general parallels between the concept of resilience and that of Disaster Risk Reduction as applied to spatial planning. These concepts are readily integrable and compatible due to their mutually complementary characteristics. Conversely, the integration between emergency planning and spatial planning may appear more challenging to implement, yet it remains equally crucial in the discourse surrounding DRR strategies, particularly in terms of linking the various phases of the disaster cycle.

Emergency - or contingency - planning involves preparing all relevant organizations to effectively respond to crises caused by a catastrophic event in a specific area. Such events can result in casualties, damage, and significant disruption to daily life. The planning process ensures that the organizations in charge of emergency management are equipped and coordinated to manage and mitigate the impacts of these events.

In essence, the goal of emergency planning is to significantly reduce the probability that a catastrophic event escalates into a state of disaster and ungovernability. The aim is to maintain the system in a condition of sufficiency. Furthermore, emergency planning is tasked with overseeing the progression of urban and territorial systems during crises, guiding the response from the initial stages of the emergency through to the protection and safety of the population. As an organizational tool, the emergency plan is grounded in the principles of management, coordination, and the optimal allocation of available resources (Menoni, 2013; Bertin, 2018).

Due to the highly operational soul of the plan, emergency plans should be often updated, according to the changes in the specific environment, risk conditions and available resources. Moreover, training and exercise must be considered part of emergency planning. For all these reasons, most authors agree on considering emergency planning as a process, rather than a static goal (Alexander, 2002; Bignami, 2010; Menoni 2013; Bertin, 2018).

According to the disaster cycle model, emergency planning happens in the preparedness phase, which is when actions are taken to reduce the impact of forecast or imminent events. However, in this case, Smith's model of the Prevision-Prevention-Response-Recovery chain (Smith, 2009) appears to be more suitable. Smith's model place emergency planning in the prevention phase, which include both mitigation actions and preparedness activity. This placement shows the intention of considering emergency planning not only as a management activity, which has to be put in place in the imminence of the event, but rather as one of the possible actions to be developed for preventing an event to become a disaster. In this case, the planning feature of emergency planning is highlighted.

Obviously, consequences of proper or scarce emergency planning are then present in the phases of the disaster cycle that follow the event. The smooth transition from the response phase to the recovery one is largely dependent on the quality of the action and of the strategic spaces considered in the emergency plan.

One of the most significant differences between emergency planning and spatial planning lies in their distinct conceptualizations of the territory within which they operate. Emergency planning tends to develop strategies that assume the environment is static, failing to consider the transformative and evolutionary characterization of the territories. On the contrary, for its own nature spatial planning aims at governing changing territories (March et al 2018).

Most common field on integration between spatial and emergency planning include the definition of shared knowledge framework. In both areas the spatialized knowledge plays a central role and the integration of the hazard information coming from emergency planning framework with exposure and vulnerability ones coming from spatial planning. This might create more comprehensive multi-risk scenario. Furthermore, the digitalization of this knowledge might enhance this integration by creating comprehensive information systems, allowing for dynamic updates and the sharing of crucial data.

Another viable area of connection between those two faces of planning might be found in the designing phase of the planning instruments, by the conjunct identification of strategic areas and infrastructures (Galderisi, 2020).

In conclusion, the integration of emergency and spatial planning is deeply connected to the specific territorial contexts in which they are applied. Both frameworks are significantly shaped by the regulatory framework in which they operate. This investigation will focus on the Italian context, particularly examining the innovations introduced by the new Civil Protection Code and the Plan Directive. (*Part II. Chapter 4: The Italian Civil Protection System*).

3 | Structural gaps in Disaster Risk Reduction

3.1 Risk Assessment

According to the Sendai Framework Terminology for DRR, Risk Assessment can be defined as the qualitative or quantitative approach to determine the nature and extent of disaster risk by analysing potential hazards and evaluating existing conditions of exposure and vulnerability that together could harm people, property, services, livelihoods and the environment on which they depend. It includes the identification of hazards, the definition of the technical characteristics of hazards such as intensity, frequency and probability, the analysis of all the different dimensions of exposure and vulnerability (physical, social, health, environmental and economic) and the evaluation of the effectiveness of prevailing and alternative coping capacities with respect to likely risk scenarios. Therefore, it appears clear how risk assessment plays a central role in the Disaster Risk Reduction discourse, particularly as the shift from evaluating single risks to considering multiple risks, including chain events and interactions among various factors, becomes necessary. Disaster risk assessment facilitates decision-makers in acquiring insights to comprehend the potential impact posed by hazards. Such assessments serve a multitude of purposes tailored to diverse stakeholders, ranging from conducting urban risk assessments to bolster disaster preparedness. Furthermore, they play a pivotal role in gauging the cost-effectiveness of investing in risk mitigation measures.

Risk assessment is, therefore, the first essential step for each DRR process (Hegenlocher et al, 2020).

While the specific objective of the research focuses on other issues related to the disaster cycle and the Disaster Risk Reduction process, for the sake of completeness the topic of risk assessment needs to be addressed, given its relevance to the general discourse. Therefore, the following lines will try to give a comprehensive but synthetic overview of the main issues associated with the topic, highlighting the most relevant challenges and gaps that risk assessment methods face.

Due to its complexity and naturally multidisciplinary nature, risk cannot be adequately characterised or evaluated by a single discipline alone, nor it is possible to define a single effective method of evaluation. In many circumstances, it is the combination of methods that are able to tackle the complexity and systemic nature of risk (Hegenlocher et al, 2020). The decision on the most appropriate approach depends on the scope of the assessment, the level of quantification, the

scale needed and the defined objectives. Moreover, risk assessment should consider the involvement of experts from both natural and social sciences, and – ideally – should go a step further and include relevant stakeholders. The collaboration among scientists, policymakers, practitioners, representatives from the private sector, and citizens is indispensable for fostering the co-creation of knowledge, enhancing trust in the public outcomes of risk assessment, and integrating co-produced risk information into evidence-based policymaking and decision-making processes (Ismail-Zadeh et al, 2017; Brown et al, 2018).

Independently from the methodology for risk assessment that is chosen, there are some common steps in the process (ISO 31000:2018):

- Risk identification: The objective of this step is to understand possible risks and their drivers, patterns, dynamics and potential consequences. The analysis of past events is essential, as well as the technical documentation and experts' knowledge. The output of this phase is most often conceptual and qualitative;
- Risk analysis: this step aims at defining frequencies and probabilities of consequences, particularly when a comparison in time or space is requested. Many are the methods and tools for this assessment steps, such as stochastic modelling/Monte Carlo simulations (e.g. Musson, 2000), system dynamics modelling (e.g. Simonovic, 2011), sensitivity analysis (e.g. Glas et al., 2016), event tree analysis (e.g. Tang et al., 2018) or composite indicators (e.g. De Groeve et al., 2016). Spatial analysis is often required, therefore spatial data become of central importance in the process.
- Risk evaluation: this is the final important step of risk assessment and has a direct link to support decision making process. In this step, risk analysis results are verified regarding context specific criteria, which strongly depend on actor's risk perception and awareness.

Risk assessment can be of quantitative or qualitative nature. Usually, quantitative risk assessment is performed hazard by hazard, evaluating the interaction of a single source of hazard with vulnerable and exposed elements (Hegenlocher et al, 2020). However, modern times and evidence have proved that risk assessment cannot be based on the single-hazard evaluation. In order to be effective, it must take into consideration different human and natural factors that affect the magnitude of risk, as well as all the possible combination of events that might rise the expected damage. To better understand risk, it is necessary to consider the possible way in which different risks can interact. This is not an easy task. Each different discipline tends to consider some specific aspects of the interaction between hazard, exposure and vulnerability. Moreover, as extensively and comprehensively explained in a significant article by Pescaroli and Alexander (2018), the boundaries between cross-risk interaction are often not clearly delineated, which can lead to confusion in identifying effective risk management and DRR actions. The authors identify three possible relations: compound risk, interaction or interconnected risk and cascading risk. Compound events are described as (1) simultaneous or successively occurring events, (2) events combined with background conditions that augment their impacts, and (3) a combination of (several) average values that result in an extreme event. On the contrary, interacting or interconnected events are mostly referred to the physical relations that are developed in the natural environment,

studying how hazard interact with exposure and vulnerability to create disaster risk. Spatial and temporal combination of hazards are often the focus. Lastly, cascading events usually show a clear link between the primary and the secondary hazards. In Pescaroli and Alexander's view, cascading events can be associated with uncontrolled chain losses involving critical infrastructure and can be the results of cumulative vulnerabilities, not necessary a chain of different hazards. The definition of the characteristics of each model of risk interaction is needed because it can affect the evaluation process, as well as the possible policy outcomes. Therefore, in order to maximize the efficiency of the multi-risk assessment process, it is important to understand differences and complementarities of compound, interacting and cascading events.

This complexity represents one of the main contemporary challenges related to risk assessment. Currently, in fact, there no standardised or systematic application of multi-risk assessment, nor there is common approach on methodology or terminology (Tilloy et al., 2019; Zschau, 2017). However, this represents one of the more relevant fields of research for disaster studies, and many progresses have been achieved regarding for instance the mapping of relevant terminology, the clarification of modelling approaches for different hazards interrelations and the development of guidelines for multi-risk management (as an example, see Lauta et al, 2018) (Hegenlocher et al, 2020).

In conclusion, those few lines have tried to give an insight on gaps and criticalities related to risk assessment in the Disaster Risk Reduction discourse. The challenges encompass various dimensions, ranging from the integration of local knowledge and intangible factors such as risk perception, behavioural patterns, values, norms, and beliefs, to the capture and representation of risk dynamics, including future scenarios influenced by nonlinearities, human-environmental interactions, and cross-scale complexities. Uncertainty is inherent in all steps of the risk assessment, from the conceptualization of risk, through the acquisition of data, to the actual analysis of risk. Different disciplines use different methodology and different terminology, making arduous the process of knowledge transfer. Thus, beyond establishing a common methodology for risk assessment, emphasis must be placed on refining communication strategies tailored to engage diverse stakeholders throughout the disaster cycle.

3.2 Creating and sharing knowledge

The previous paragraph has highlighted how the risk assessment process necessitates the interrelation and connection of various disciplines and multiple stakeholders, introducing the concept of the science – policy interface in Disaster Risk Reduction. This can be defined as the relation between scientific experts, policymakers and other actors *"which allow for the exchanges, co-evolution and joints construction of knowledge, with the aim of enriching decision making"* (Van den Hove, 2007, p.815). The role of scientist is therefore becoming increasingly relevant in society, a change that impose major implication in different fields, such

as the one of the responsibilities of scientific advisors in case of adverse effects of policy's decision. One main issue related to the topic regards how science is included into policy making, pointing out the dichotomy of policy makers that need the expert's opinion, but that not always implement that into policy, as economic, societal and political implication might also influence the final decision. In disaster situations this dilemma is even emphasized, as disasters accelerate the policy domain for speed, in opposition to science's need (Albris et al, 2020).

Hence, it appears clear how one central topic in the DRR science – policy interface lays in a matter of communication and knowledge transfer, as each actor included in the process needs to reciprocally recognize instrument and methods of creation and use of the knowledge necessary for effective risk reduction actions.

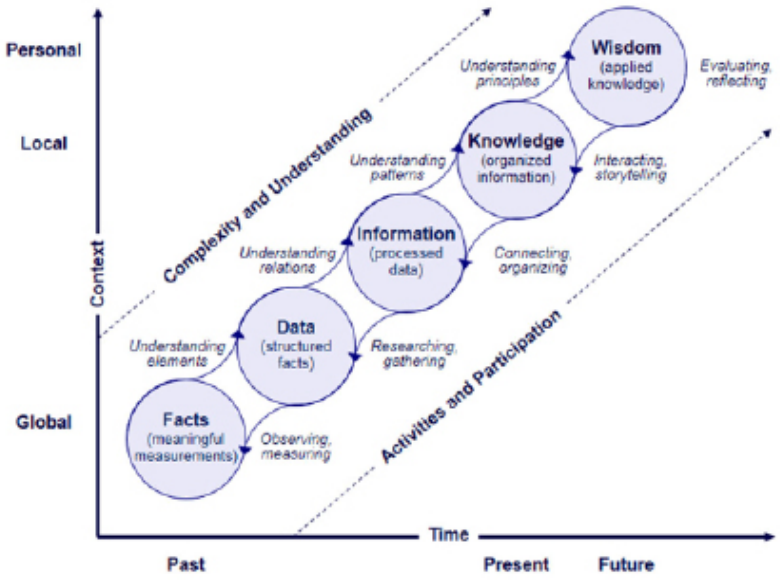
Tackling the issue of knowledge transfer implies first of all questioning the meaning of the term. The intention of this clarification is only intended for the purpose of the research; being well aware of the complexity of the topic and of the possible theoretical dissertation, the following lines will try to define a simplify concept of knowledge and knowledge creation and transmission, instrumental for the creation of a common ground for the subsequential analysis of the case study.

Knowledge creation

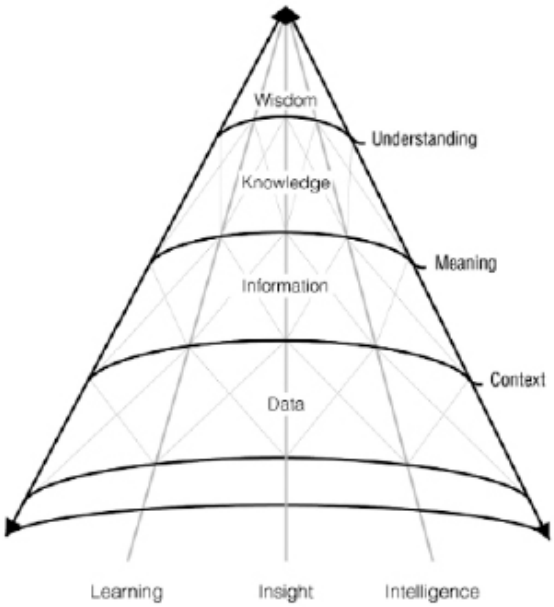
Common definitions tends to confuse the concept of knowledge with the one of *"providing information"* (Weichselgartner & Pigeon, 2015), while the description of the process of knowledge creation can serve an useful model for the understanding of the difference between these two concepts. One famous framework, initially illustrated by Ackoff (1989) in the field of system analysis for business application, is the one that distinguish between data, information, knowledge and (sometimes) wisdom. This model represents the traditional approach used in the field of knowledge management. According to the model, data can be considered as a set of facts, not processed nor contextualized into meaningful information, which are collected in order to improve the understanding of a certain reality. Data can turn into information if contextualized. Knowing the context of data acquisition, as well as the purpose, is highly significant and requires the data analyst to have a profound understanding of the data itself, and also of the wider system in which the data are acquired (Spiekermann et al., 2015). The accumulation and organization of information creates knowledge. Knowledge is a dynamic concept, built through social interaction and experience. Wisdom is the last step of this conceptual pyramid, it is knowledge integrated and applied, filtered by personal experience and therefore created within people. In the transition from data to wisdom, the degree of participation and understanding increase, resulting in higher complexity. The transition from one step of the model to the subsequential must not be considered as fixed, as the border between the concept are blurred and the progression is not linear, but, on the contrary, it is characterized by feedback and loops. Figure 6 well describes the concepts explained above.

While this model can help in the understanding of the production process of knowledge, in order to completely define the concept, it is also relevant to highlight the coexistence of different types of knowledge.

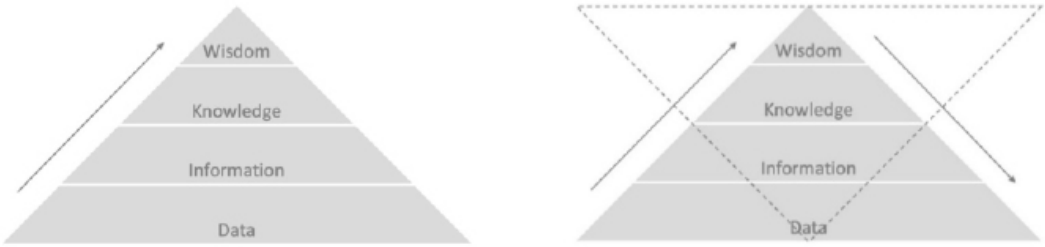
The first and most common division is between *"scientific knowledge"* and *"local knowledge"*. Scientific knowledge is often approached as a formal agreed



The continuum of understanding
Source: Weichselgartner and Pigeon 2015



The data - information - knowledge - wisdom web
Source: Spiekermann et al 2015



The knowledge Pyramid. Linear and Bidirectional data - knowledge relation
Source: Faiella et all 2022

Figure 6. Different representation of the knowledge framework by Ackoff (1889)

methodology or education, in opposition to local knowledge, which is more often intended as native ways of understanding the context, based on the accumulation of knowledge by people who daily live the natural environment and are tied to the cultural and historical context of a certain settlement or community (Gaillard and Mercer, 2012; Mercer 2012). One relevant deficit of many studies on DRR, is the assumption that scientific knowledge is the first primary source of credible knowledge, thus defining a sort of ranking and overlooking the fact that scientific knowledge is embedded within larger systems of power, cultural dynamics and context (Hermans et al 2022; Spiekermann et al 2015, Gaillard and Mercer 2012). However, recent trends are showing a more interconnected way of intending knowledge, recognizing the relevant role of local knowledge in the definition of DRR strategies and action .

Another common distinction is the one between explicit and tacit knowledge. Explicit knowledge refers to information that is capable of being captured and documented within records or databases. It adheres to formal and systematic structures, facilitating easy dissemination and sharing. It includes patents, instructional manuals, documented procedures, best practices and research findings. Explicit knowledge can be structured and unstructured. Structured knowledge concerns data or information organized in a specific manner to enable future retrieval, such as documents or databases. On the contrary, unstructured knowledge encompasses content like emails, images, training materials, and audiovisual resources, where information is not organized for direct retrieval. The concept of explicit knowledge is easily associable with the one of scientific knowledge. Differently, tacit knowledge represents the internalized knowledge of each individual. It lacks tangible form and is often characterized as an unarticulated understanding of a subject matter, therefore accessing tacit knowledge can be difficult. Effective sharing of tacit knowledge typically necessitates substantial interpersonal interaction and trust (Cong and Pandya, 2003).

Two are the relevant condition that emerge from the definition on knowledge described above: firstly, the non-linear nature of the knowledge acquisition process, marked by feedback loops rather than a linear progression; and secondly, the profound influence of personal experience and social context in shaping not just tacit and localized knowledge, but also scientific one. Thus, a comprehensive understanding of knowledge necessitates the integration of these multiple aspects.

3.3 Risk Knowledge transfer

This holistic conception of knowledge has now become a mainstream discourse and is well-received by projects and research focusing on risk reduction. The same SFDRR set as priority for action “Understanding Disaster Risk”.

However, despite the alignment of perspectives, the implementation of methods and tools to create shared and multi-domain knowledge, and to transfer this knowledge to the various stakeholders involved in the disaster cycle, remains one of the most significant gaps related to risk reduction processes.

Stealing a phrase from a famous paper by White et al. (2001) - which has aged

extremely well - we could assert that *"more is known and more is lost"* (White et al, 2001, p.89). The authors begin their thinking by observing a simple fact:

"While loss of life from natural hazards is still large, it is declining not only in the United States but also on a worldwide basis. Losses of property are large and continue to grow in the United States and worldwide. […] Given the growth in knowledge could better results have been expected?" (White et al, 2001, p.89).

Moving from consideration related to specific numbers, which for a matter of time cannot be considered significant anymore and have been substituted by more updated reports and investigation , the underlying message of the text concerns the extremely contemporary issue of the difficulty in transferring the enormous body of risk knowledge at our disposal into effective DRR policies. In answering five simple questions[1], the authors explore the different reasons for this lost, reaching two conclusive remarks, which identify two central aspects.

The first concerns the need to construct risk knowledge in an integrated manner, incorporating perspectives from diverse levels and stakeholders implicated in the process, thus linking back to the discourse on the different types of knowledge, but also to those on risk assessment. It posits that knowledge acquisition must be a collaborative endeavor, necessitating co-production.

The second, on the other hand, recognises the need for a systemic vision that integrates DRR processes into a broader framework of sustainable development from different perspectives. Hence, the very nature of knowledge and its process of creations are the fields to investigate for identifying knowledge transfer fragmentation.

According to Albris et al (2020), knowledge transfer fragmentation is due to epistemological, institutional and strategic reasons.

The first one refers to the fact that the very conception of knowledge is conceived differently from the different actors involved in the process of DRR, especially if they belong to the science and the policy fields. As already mentioned in the beginning of this paragraph, science needs time and rests on a basis of uncertainty, that makes hard the provision of clear-cut policy recommendations. Some of the differences between scientists' and policy makers' visions make inherently difficult to integrate the results of research into practice.

Institutional reasons lay in the lack or inefficiency of structures and protocols that facilitates the transfer of scientific evidence to the governance sphere. Without the definition of new institutions (or changes in the existing ones) specifically dedicated to it, the involvement of the scientific community is dependant from the will of policymakers.

Finally, strategic reasons are due to the lack of common vision and goals, which results in difficulties in communication. Knowledge transfer happen mostly within disciplines, but it does not overcome sectoral barriers.

Efficient sharing and communication strategies seems key. The systematic organization of information and knowledge can provide a solution to the issue of transmission. Many European and international projects are indeed moving in this

1 Is knowledge lacking? Is knowledge not used? Is knowledge used ineffectively? Is there a time lag? Is an overwhelming increase in vulnerability the cause? (White et al, 2001).

direction, having developed online platforms for sharing best practices or territorial information systems (Menoni and Faiella, 2020).

This digital transition plays a crucial role in creating digital arenas for exchange. However, the technological aspect should not be approached in a sterile manner with a naive faith in the tools themselves, as they bring with them not only vast opportunities but also significant challenges.

3.3.1 The role of Spatial Data Infrastructure

Technological innovation in data acquisition, analysis, and utilization has significantly enhanced the quantity and quality of spatial information available. This advancement has paved the way for creating models and virtual environments to simulate events, assess policy impacts, and facilitate interaction among stakeholders. Traditional cartography's ability to spatialize information has been exponentially enhanced (Laurini, 2017).

The knowledge frameworks identified in the previous paragraph are well-suited for implementation as Spatial Data Infrastructures (SDIs).

The creation of virtual spaces for discussion and analysis is crucial for establishing the necessary context to transition from simple data collection to structured knowledge. Spatial Data Infrastructures are designed to enable this process.

An SDI refers to a framework that enables management, sharing, and use of geospatial data across different organizations and sectors. It consists of technologies, policies, standards, and human resources necessary to acquire, process, store, distribute, and improve the utilization of spatial data (Groot & McLaughlin, 2000; Masser,2005; Idrizi, 2018).

A well-designed SDI allows us to move from the simple accumulation of data to structuring it to create information and knowledge.

Furthermore, human resources are among the components of a spatial data infrastructure; therefore, human-machine interaction can potentially help overcome the final step of the knowledge framework, internalizing risk knowledge and transforming it into wisdom. The construction of SDI requires a strong vision, specific and tangible objective and full commitment of human, organizational and financial resources (Masser, 2005).

Theoretically, the construction of efficient SDI could help partially overcome the epistemological, institutional and – most importantly - strategic reasons for Risk Transfer fragmentation identified by Albris et al. (2020).

As introduced in the previous lines in fact, SDIs must be conceived with a strong vision and goal, as well as clear and tangible objective. This type of approach

is common in the construction of geospatial models; for example, the identification of objectives and requirements is often considered one of the initial steps in the implementation of relational databases (Butler, 2015). For the development of an effective and efficient SDI, it is essential that the stakeholders involved in the processes collaborate in the formulation of common objectives, thus initiating the path towards overcoming the strategic gap.

Moreover, in relation to the epistemological gap, the creation of shared digital models requires the parties involved to establish common languages, both in relation to technical matters - where standardization efforts, such as the INSPIRE directive[1], provide valuable assistance - and in relation to ontological issues.

While on a theoretical basis the implementation of an SDI seams the most effective strategy for overcoming barriers to risk knowledge transfer, practical operationalization of this system shows severe criticalities.

Viewing the core components of SDI as policy, access network, technical standards, people and data, based on the different nature of their interactions within the SDI framework, different categories can be formed: the first one could consider the important role between people and data, while the second can consider the access network, policy and standards - the main technological components (Figure 7). The criticalities in the operationalization of SDI belong to both categories.

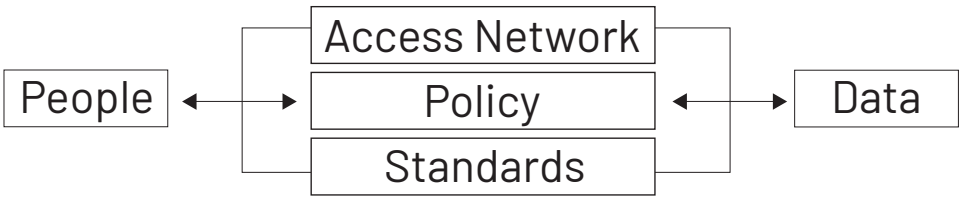


Figure 7. Nature and Relations between SDIs components
Source: Rajabifard et al, 2002

1 The INSPIRE Directive aims to create a European Union Spatial Data Infrastructure (SDI) for the purposes of EU environmental policies and policies or activities which may have an impact on the environment. This European Spatial Data Infrastructure will enable the sharing of environmental spatial information among public sector organisations, facilitate public access to spatial information across Europe and assist in policy-making across boundaries. Source: https://knowledge-base.inspire.ec.europa.eu/overview_en (Last access on: 06/10/2024)

As for the second category, its nature is very dynamic due to the rapidity with which technology develops and the need for mediation of rights, restrictions and responsibilities between people and data change.

This suggests an integrated SDI cannot be composed of spatial data, value-added services and end-users alone, but instead involves other important issues regarding interoperability, policies, standards and networks (Rajabifard et al, 2002).

Referring to the interoperability and standardization sphere, they are challenging since they require not only technical solutions but also collaborative frameworks and agreements between different stakeholders, which introduce administrative and normative issues in the discourse. International organizations, such as the *Open Geospatial Consortium (OGC)*, work towards developing and promoting standards for geospatial data. Despite these efforts, achieving universal compliance remains challenging, as control over data often rests with multiple agencies and organizations, each with its own protocols, formats, and standards. This fragmentation can lead to inconsistencies and gaps in the data, hindering its effective use.

In conclusion, SDIs – and more generally technological instruments that enhance the digital transition – can be useful and effective technical instruments of knowledge creation and transfer. However, considering the great importance of human resources in the infrastructure, their effective use is inevitably tied to governance issues.

3.4 Risk awareness

The evolution of the risk concept has brought to light the central role played by people in Disaster Risk Reduction processes. People are not anymore just exposed to risk, but on the contrary, they can become active individuals, which from object of the process become subject. This is one of the reasons why in the past few decades, decision making in disaster management has witnessed a transition from a top-down, command and control style of management to the encouragement of citizens participation (Alexander 2002a; Classen et al 2020).

Participation comes in a multitude of diverse forms and with several level of engagement, from public hearings to social media campaign, from inclusion in formal decision making to communication campaign to increase risk awareness.

Risk awareness is one central and highly debated topic related to DRR. Despite the many years of research on the topic, it still remains unsolved, in the sense that it is still not clear to what extent institutions and individual are aware of risk and how or whether a perception of risk leads to greater levels of preparedness (Albris et al., 2020). The study of risk awareness and perception has a long history (Tierney, 2014) and span different paradigms and research programs, from psychometric approaches to social amplification of risk, to cultural approaches. However, the issues continue to exist, and the problems outlined from previous works on the subject appear to be highly similar to the one faced today (Albris et al., 2020).

One great challenge in Disaster Risk Reduction is communication. Effectively conveying complex concepts, technical terminology, and diverse risk perceptions is

difficult, not only to the general public but also across different scientific disciplines. This requires translating intricate scientific data into accessible information without oversimplifying it, ensuring that all stakeholders, from policymakers to local communities, can understand and act upon it.

Another one concern the willingness of people to take action against risk and whether or not this willingness is connected to higher levels of risk consciousness (Krüger et al, 2015; Kelman, 2018).

The latter concept is well explained by the theory of the risk perception paradox by Wachinger et al (2013). According to the authors, the connection between risk perception, willingness to act and risk preparedness is not clear and while the general belief is to consider those three aspects directly proportional (high risk perception leads to more willingness to act and, therefore, to major risk preparedness), many studies have proven that this is not always the case and that, on the contrary, that connection appears rather weak. Many researches have, for example, proved that even though individuals have experience and high risk perception, they seldom take preparedness actions (Miceli et al, 2008; Lin et al 2008) and other authors have recently revised the models that connected input factors between risk perception and preparedness actions (Paton et al, 2008).

The authors find three possible explications for this disconnection and relate these three reasons to some intervening variables:

1. Experience and motivation,
2. Trust and responsibility
3. Personal ability.

The first reason is linked to the expectation of people living in a risky zone. Individuals, in fact, understand risk, but deliberately chose to accept is as the perceived benefits outweigh the potential negative impact. The motivations for this choice are multiple: people might have risks that are perceived as more serious to deal with (as for instance social or economic issues), or the need to secure daily livelihoods is mentally more important than risk perception, or again there might be an underestimation of the actual level of risk that affects the area. Lastly, cultural reasons might tie people to a certain location despite the risk affecting it, therefore the significance of place and emotional attachment plays a crucial role (Kruger et al 2015; Fera 2019).

The second possible reason for the risk perception paradox is linked to trust and personal responsibility: Individuals understand the risk but do not realize any agency for their own actions and this agency is transferred to someone else. Higher trust in structural or governance measure to keep one's safe will result in less likely to act, as individuals will transfer this responsibility to them.

Finally, the third reason for the risk perception paradox is connected to confusion or ignorance about the appropriate action to take. Individuals understand the risk but feel to have little resources to affect the situation, consequently it is not just a matter of raising people risk perception but also of providing individuals with the capacity to affect their own situation.

The theory exposed by the authors seems to propose that the link between experience and preparedness is more complex than what it seems. Experience of a risk situation or specific disaster and trust in authorities and experts are the fundamental elements that shape individual risk perception, often coupled with many other casual factors such as cultural, social or economic characteristics. However, and despite the many studies on the topic, the relationship between risk perception and behavioural response is still unclear and controversial. The general assumption that high risk perception will lead to personal proactive action is actually dependant on many contextual factors which might change the expected outcome. This intricate relation has practical implication for risk management. What emerges from the studies analysed by the authors of the work is that public participation seems the most effectively means to create awareness of potential disasters.

Furthermore, those analysis demonstrates that participatory processes significantly enhance individuals' risk perception. Such involvement increases trust in authorities and experts while fostering a sense of personal agency in self-protection. When people actively participate in designing and testing emergency plans, they gain a clearer understanding of the capabilities and limitations of authorities and the specific actions each resident can take to improve protection and crisis management.

This participatory engagement serves as a crucial tool for cultivating and promoting trust between the community and those responsible for managing risks. By engaging community members directly in the planning process, authorities can build more resilient and informed communities, ensuring that emergency plans are not only well understood but also effectively implemented. The mutual trust developed through these collaborative efforts is essential for successful disaster risk reduction, as it encourages greater cooperation and compliance with safety measures, ultimately leading to a more prepared and resilient society.

3.5 Risk Governance: Who governs Disaster Risk Reduction?

Among the relevant gaps identified in the process of Disaster Risk Reduction, there is the one of Disaster Risk Governance. In fact, being risk essentially socially constructed, risk governance processes are vital to reduce the impact of catastrophic events.

The topic of Disaster Risk Governance (DRG) started to become central in the discourse in the early 1990s, with the declaration of the International Decade for Natural Disaster Reduction[1]. In that occasion, nations have recognize Disaster Risk Reduction as a shared problem, to tackle globally (Jones et al., 2015). Then, with the Hyogo Framework for Action (2005) and the Sendai Framework for Disaster Risk Reduction (2015) the topic has gained stronger recognition, catalysing a transformation from reactive measure, i.e. "response and recovery", to proactive strategies, i.e. "prevision and prevention" (Tierney, 2012; UNDRR, 2015). Moreover, the Sendai Framework for Disaster Risk Reduction acknowledges the

1 UN resolution 42/169 of the 11th of December, 1987 – International Decade for Natural Disaster Reduction

centrality of themes related to Disaster Risk Governance, to the extent that it places it as second among its priorities for actions: Strengthening disaster risk governance to manage disaster risk (UNDRR, 2015).

A specific definition of risk governance is given by Tierney (2012):

"The interrelated sets of norms, organizational and institutional actors, and practices (spanning predisaster, transdisaster, and postdisaster periods) that are designed to reduce the impacts and losses associated with disasters arising from natural and technological agents and from intentional acts of terrorism."

Analysing Tierney's definition, one relevant point that characterize risk governance is represented by the temporality. Risk Governance is composed by norms, actors and practices "spanning from predisaster, transdisaster and postdisaster periods", in accordance with the concept of disaster cycle that has been highlighted in the previous paragraph. Therefore, risk governance is something to be taken into consideration not only for emergency management or reconstruction, but, on the contrary, it is a sector that needs continuity of actions and policies. In this regard, a common characteristic of RG policies and programs is that they tend to be reactive, concentrating on solving issues revealed by recent events, rather than being based on preventive and comprehensive risk assessment. This is the logic by which the production of most legislative acts and regulations related to civil protection has evolved, at the Italian, European, and international levels, as for instance in the case of the of the evolution of the tsunami monitoring system in Southeast Asia following the 2004 disaster (Tierney, 2012; Bignami, 2010).

Variability, complexity, multiscalarity, comprehensiveness and polycentrism can be regarded as the main attributes of risk governance systems. Variability is intended with respect to the participation of several entities across the temporal phases of the disaster cycle, while complexity and multiscalarity refer to the multiple scale of activities and the multitude of actors involved. Comprehensiveness indicate the integration in the discourse of different type of risks. Lastly, polycentrism encompasses the diverse array of network actors spanning global institutions to regional, national, and subnational entities, as well as non-governmental organizations (NGOs) and private sector entities. Consequently, risk governance goes beyond governmental setting, norms, powers, processes and tools through participation and engagement of all stakeholder at different scales.

The concept of governance itself stems, in part, from the acknowledgment that roles once exclusively held by public entities are now often distributed among a variety of actors, encompassing not only governmental institutions but also entities from the private sector and civil society (Agranoff, McGuire, 2003; Goldsmith, Eggars,2004).

According to Jones, Manyena, and Walsh (2015), this redistribution of state roles happened at three different level: upward, outward and downward.

The upward mechanism refers to the process that has already been introduced in the first lines of this paragraph, in relation with the recognition of the topic of Disaster Risk Reduction ad a global issue. This recognition involved a redistribution of power and influences upward, to institution such as the United Nations and the

World Bank. The early steps in this shift can be traced back to the establishment of United Nations Disaster Relief Office (UNDRO) in the 1970s, the ancestor of the actual United Nation Office for Disaster Risk Reduction (UNDRR), until the drafting of international agreement such as the Sendai Framework for Disaster Risk Reduction. In this process, member states need to report to the Secretary General on the progress of each county in the field of DRR. Furthermore, at the Eu level, national level decision making is related to EU level directive and polices, therefore indicating a vertical alignment in decision making process (Rauken et al 2015).

Outward is intended in the sense of the need for the state to integrate Disaster Risk Reduction throughout different administrative levels and sectors, including as well private partners (eg. Insurance companies) and nongovernmental organization. The complexity of issues associated to disaster risk reduction policy, in fact, cannot be addressed by a single governmental department, but in the contrary, needs to be mainstreamed, together with other subject as for instance environmental policy.

Then, downward mechanism can be viewed as being synonymous with decentralization, that can happen both within the state and non-state authorities (e.g. NGOs). Considering state authorities, the advantages of decentralization include that members of the local government are the first to respond in case of disaster and that local knowledge may prove useful in managing disaster risk[2]. Furthermore, local authorities can intervene not only in case of emergency management, but also and more important with structural and non-structural activities of DRR such as the modification of building code, zoning enforcement, police and fire services, transportation and health services, emergency preparation and critical infrastructure investment. However, a broad consensus exists in the literature that central governments need to play a role in designing and implementing comprehensive disaster risk management systems and some experts argue that the national government must retain DRR responsibility, policy and programming to ensure it has adequate political profile and resources (Tarazona, Scott, 2011).

Decentralization can also happen beyond the state, including in a broad group the redistribution of the authority downward, therefore considering non – institutional process that include both NGOs and bottom-up community organization.

Upward and downward mechanism refers to vertical governance relationship, while outward mechanism concerns horizontal ones (Renn, 2008). Horizontal governance relationship involves actors' network that operate within the same geographical context, such as different authorities of a same administrative context or watershed, as well as the different departments of a statal organization. Vertical governance relationships are those that involve ties among local and supralocal entities, i.e. municipality, provinces, regions, nation, and international level. All local decision making processes have a vertical component, as local authority is derived or delegated from higher authority. This distinction between vertical and horizontal level of governance is not only connected to risk governance, but on the contrary, is common for many different subjects, as for instance environmental governance.

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2 This is the concept on which the organization of the Civil Protection is based. The topic will be further explained in *Chapter 4*

Starting from the analysis of the main mechanisms describing the processes of risk governance, it can therefore be stated that there is no single formula that identifies the effectiveness of these processes. There is no consensus that bottom – up processes work better than top – down ones, nor that institutional management functions better than non-institutional ones. Moreover, as many other governance mechanisms, risk governance is influenced by socio-economic and cultural factors, resulting in a variety of different possibilities, based on the national context and other environmental and contextual issues.

However, empirical evidence seems to demonstrate that the principle of subsidiarity, i.e. the decentralization of responsibilities and resources to the lowest level that can effectively perform necessary tasks, appears to be the key for effective Disaster Risk Reduction (Jones et al., 2015). But the challenge is to understand which is the most appropriate level for the management of each function, taking into consideration the typology of risk or catastrophic event, the extension, the intensity and the short term and long-term impact.

The central question regarding the topic of Risk Governance thus remains focused on competencies, as within this complex framework, it proves challenging to clearly define the tasks and responsibilities of the involved actors.

Part II.

Case study analysis: the Italian Civil Protection System

It is difficult to provide a comprehensive definition of Civil Protection. The subject has often been dismissed as being too dedicated to action and there is a lack of theoretical studies that investigate the very meaning of the term. However, in the analysis of the various definitions given by the different entities and authors it is possible to trace some common elements that outline the modern civil protection.

According to the definition given by ECHO - European Civil Protection and Humanitarian Aid Operations entity,

"Civil Protection consists of governmental aid delivered in preparation for or immediately after a disaster strikes (in Europe and worldwide). The aid provided takes various forms: supplies, specialised teams, such as firefighters or search and rescue teams, experts assessing and coordinating support right on the ground (and repatriation of EU citizens)".

In this first definition, three fundamental pillars of Civil Protection are introduced.

First, Civil Protection is a governmental responsibility, therefore institutions and administrative bodies represent central players. The subject of Civil Protection falls within institutional responsibility, according to the different territorial levels and jurisdictions, and is coupled with environmental policies, territorial and urban governance (Bignami, 2010). Most of the countries of the world have developed their own Civil Protection agencies as well as international agreements among states, such as ECHO (European Civil Protection and Humanitarian Aid Operations). It is no coincidence that civil protection has gradually emerged from civil defence (Alexander, 2002), having then progressively changed structure, procedure and organization.

Second, Civil Protection acts *"in preparation and immediately after a disaster",* i.e., it represents the main entity in charge during emergency planning and emergency management. This provides the temporal framework of actions entrusted to Civil

Protection, even if, as it has been highlighted in the previous chapters, effective disaster and emergency managements needs continuity throughout the whole disaster cycle.

Lastly, the definition provided by the European Union introduces different forms of governmental aids provided by the Civil Protection. This aid might be material (i.e., "supplies"), technical (i.e., "specialised teams") or logistical. This part of the definition is relevant since it refers to the structure and composition of the Civil Protection, giving an idea of the complexity of a system that encompasses a multiplicity of elements of different natures.

A less institutional definition is given by Bertin (2014), who defines the Civil Protection as a *disaster operator,* which has the role of securing the area affected by a disaster, restoring communications, roads and land governance, helping the population with health assistance and accommodation until administrative stability has returned. In this definition, again, the topics highlighted previously emerged: the central role in emergency management and planning, the multiplicity of actions included in the competence of the agency, the institutional role played and the temporality of the action. What is interesting in Bertin's definition is the use of the term "*operator*", which is usually applied to someone working on a machine. The comparison seems rather appropriate. Exactly as each component of a machine needs to have a specific function and work together with the other gears, the Civil Protection is formed by a multiplicity of elements with specific roles that synchronize on a common objective. Indeed, it is rather common to use terms such as Civil Protection mechanism or Civil Protection system, indicating the character of the organization.

Part II of this dissertation explores Italian Civil Protection, as it is the main agent in the emergency management and planning process at a national level. *Chapter 4: The Italian Civil Protection System,* is dedicated to an overview of the system's characteristics, including norms, tools and procedures that shape the form of it. The choice of analyzing the Civil Protection system derives from its binary condition of main character and evanescent figure of the Disaster Risk Reduction discourse. While it occupies a pivotal role when dealing with emergency management and planning, its importance and presence seems to fade away during the other phases of the disaster cycle, especially when it comes to the integration with structuring spatial planning intervention. Civil Protection plans are often considered by planners as too operational and dedicated to action, while the same Civil Protection officers seem to underestimate the spatial relevance of their planning decisions.

However, the analysis of the risk governance framework has highlighted how Civil Protection is undoubtedly central in Disaster Risk Reduction process; this is true for both its presence as vertical inter-scale institutional agency - at the different territorial levels, according to the principle of subsidiary– and for the instruments it adopts, in terms of plans and practices.

The decision to further investigate the Italian system derives from various reasons, among which – no less important – is the personal research interest in the national context. Moreover, the will to analyse the Italian panorama comes from some interesting progress in the normative field that occurred recently and that

represented an attempt of the Civil Protection System to improve the effectiveness of its work. As it will be better explained in *Chapter 4,* in recent years, Italy has been object of a reorganizations of Civil Protection norms, which resulted in the 2018 definition of the new *Civil Protection Code* (Legislative Decree no 1 of the 2nd of January 2018), followed by the *Directive of the 30 of April 2021 – Guideline for the Drafting of Civil Protection plan.* It was therefore interesting to observe first implementation and changes introduced by the new norms.

The path developed in *Chapter 4* is functional for the discussion of *Chapter 5 and 6*, dedicated to the analysis of two specific activities: the national level exercise *EXE Sisma dello Stretto* and the participatory project for the updating of the Civil Protection Plan of the town of Bagnara Calabra.

Those cases are useful to draw general conclusion that go beyond the specific event analyzed, giving a relevant and representative vision of a bounded system like the one of Italian Civil Protection.

The choice of the specific activities to follow derives firstly from the recognition of the need for direct observation. As it is highlighted by Menoni (2020), the field of Civil Protection is not the subject of extensive scientific literature, being a field generally seen as much more operational than theoretical. She stresses the need of direct observation, for planners and practitioners in general, of emergency management activities; without field experience is almost impossible to propose relevant question and solutions. This consideration was fundamental not only for the definition of the case studies, but also for the general development of the fieldwork activities and research question.

To define the specific activity which could have been object of the study, among the many conducted by the Department, three characteristics were significant:

1. It needed to be an activity as representative as possible of the work of the Civil Protection during emergency management;
2. It needed to include as many different stakeholders and territorial level of governance as possible, in order to better observe the interaction of all these different components;
3. It needed to be ongoing, as to have the possibility of direct interaction and observation of the operations.

Based on these considerations, the decision of analysing the Civil Protection exercise *Sisma dello Stretto 2022* and participatory process in Bagnara Calabra was made. Those two activities, in fact, constitute two critical moments in the disaster cycle. The first simulates a disaster of national relevance, thus representing the moment of initial management of the emergency, with the consequent activation of the civil protection mechanism in its entirety. The possibility to directly observe this process is extremely relevant for the research as, especially for the Italian context, it is not documented by scientific literature and most of the material used within the organization is of restricted access.

The second activity, the participatory planning in Bagnara Calabra, is framed in the preparedness and mitigation phase. This project started in the occasion of the exercise, as Bagnara Calabra was selected by the Civil Protection Department as

a possible interesting use-case for testing participatory planning methodologies. In this case the interest is in the inclusion of the community as relevant stakeholder in the emergency planning process, searching for evidence of the effectiveness of community engagement for DRR .

The analysis of the case studies aimed at the empirical investigation of the critical categories identified with the DRR gaps highlighted in *Part I*. The work carried out in the two cases exhibits methodological similarities in terms of data collection procedures, while it differs in terms of the critical categories sought in the various activities.

EXE Sisma dello Stretto is analyzed in relation to the risk knowledge transfer gap. Calamitous events, even when simulated, like in this case, serves as an opportunity for generating risk-related knowledge, which however is not always efficiently translated into instruments and policies for risk management and mitigation (Faiella et al., 2022). This process will be sought after during the *EXE Sisma dello Stretto,* focusing the attention on the use of SDI for risk knowledge creation and transfer.

It will be analysed the implementation of a specific configuration on the Territorial Information System of the Civil Protection (SIT DPC), the "*Catalogo Mappe interattive della Protezione Civile*" (Civil Protection Interactive Map Catalogue) and its interoperability with other platform emergency management related. This activity enables to investigate the role of technology in helping the efficient management of the new information created during (simulated) disastrous event. Moreover, analysing the criteria underlying the implementation of a SDI created for a Civil Protection exercise can help us understand the methods of data and information selection, thus providing an indication of what is deemed necessary for Civil Protection purposes. Additionally, through interviews with the technicians responsible for the project, it is possible to understand the actual utilization of the tool and thereby derive insights into the perceived effectiveness of the digital transition.

This analysis will highlight potentials and criticalities of the use of spatial infrastructure for risk knowledge creation and transfer. However, for this knowledge to become effective in increasing capacity for DRR, it must be translated into structural and non-structural interventions. The transition from risk knowledge to risk awareness and willingness to act is not straightforward, as already explained in *Chapter 3.*

This concept will be deepened with the second case study, the participatory process for the drafting of the Civil Protection plan of Bagnara Calabra. In this case, the focus is on two gaps. First, the retracing of the risk governance network, as the variety of stakeholders included in the participatory process well represents the comprehensiveness, complexity and multiscalarity highlighted in the risk governance discourse. Then, the raising of risk awareness in the community and whether participatory process was valuable for the activation of structural interventions at the local level.

4 | The Italian Civil Protection System

4.1 The evolution of the Italian Civil Protection

The definition of the modern Italian Civil Protection mechanism is directly connected with the development of the current institutional system and has been highly influenced by the succession of calamitous event, of higher or lower intensity, which happened along the years on the Italian territory. In order to understand the process that has shaped the modern Civil Protection, a brief overview of the most significant catastrophic events, their management and the changes that took place after them will be exposed in this section.

The aim of this paragraph is not to deep the legislative evolution related to the topic in the Italian history, but rather to trace the change in the approach to the issue of Civil Protection and to illustrate its transformation from an institutional point of view. This is relevant not only to understand the reason behind the division of competences between bodies and institutions in modern Civil Protection, but also to discern the fundamental features of the system, that sometimes might reveal unsolved nodes in the current mechanism.

The main reference of this section is the attentive reconstruction that is made by Daniele F. Bignami, in the fourth chapter of its book "*Protezione Civile e riduzione del rischio disastri*" (Civil Protection and Disaster Risk Reduction) (2010), for what concerns the period that goes from the unification of Italy until the first years of 2000. Bignami's reconstruction stops before L'Aquila earthquake of 2009, which is a particularly relevant episode for the definition of the current organization of the Civil Protection, since some episodes and procedures deployed in that occasion would have reshaped the system in the following years. For the reconstruction of the years from 2009 until today, different sources and authors will be used and will be properly mentioned along the text.

It is instrumental for the purpose of this overview to divide the evolutionary path of the modern Civil Protection into three periods:

- The "*rescue period*", from the unification of Italy until the end of the second world war, when major concerns were focused on post-event rescue operations.
- The "*construction period*", from the establishment of the Italian Republic to the early 1990s, when major events oblige the institution to shape the form and competence of the Civil Protection;
- The "*operative period*", from early 1990s to today, when the institutional definition of the Civil Protection is defined.

The rescue period

During the "rescue period", there is no formal definition of a Civil Protection system and the rescue operation are mainly managed by local administrative authorities (mayors and prefects) and carried out with the help of the army, together with religious organizations and authorities.

Although there is a lack of legislative initiatives to formally establish national intervention and rescue bodies, there is a growing intuition of the need of preventive risk reduction actions, especially after the great Messina earthquake of 1908. In 1909 in fact, the first Royal Decree of seismic classification of the territories hit by the earthquake, with subsequential construction norms, was issued, followed some years later by a norm about hydrogeological arrangements for mountain basins[1].

Finally, in 1919 a first service for the organization of the rescue intervention in case of earthquake was issued and the management of the service was assigned to the Ministry of Public Works. The Ministry of Public Works will be in charge of rescue coordination during the whole fascist regime, managing as well the intervention of all the other governmental structures: army, red cross, rail service and mail service.

There was a strong political control over the structure and activities of public security (such as dangerous industries or – above all – control over explosive materials) were incorporate into the competences of the Ministry. Rescue operations were always treated as singular and unexpected event, the concept of emergency planning was still far from development. From a social perspective, this period is characterized by a fatalistic approach to the disaster.

The construction period

After the second world war and the establishment of the Italian Republic, the role of rescue management is still in the competence of the Ministry of Public Works. Those years can be considered the "construction period" since is the timeframe in which the foundation of the modern Civil Protection system is staring to grow.

An illustrative episode of the debate on the character of Civil Protection that occurred in those years is provided by a bill in 1950, which proposed transferring Civil Protection competencies from the Ministry of Public Works to the Ministry of the Interior, prefectures and police forces, also in charge of a voluntary militia. This kind of approach focused more on war risk than on disaster risk. What prevented the approval of this proposal was the intrinsic connection between Civil Protection and civil defence, which made the government oppositions fear that the objectives of the proposed regulations were political and that the volunteer militias could become a kind of paramilitary corps, creating an emergency system framed within the armed forces. The one in 1950 was only the first of a series of attempts in this direction, which continued until the 1970s, always nixed (Pizzi and Zamberletti, 2006).

From a legislative point of view, the 1960s produced improvements compared to the previous decade, partly due to the disastrous events they faced that stirred the political debate. A series of laws and decrees enshrined the importance of protecting

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1 Law n.774 of 1911 "*Norme per la sistemazione idraulico forestale dei bacini montani, per le altre opere idrauliche e per le bonifiche*" (Rules for the hydraulic forestry of mountain basins, for other hydraulic works and for land reclamation)

human life and essential goods as an institutional obligation for a modern state and the first steps were taken towards the contemporary concept of Civil Protection. This was caused also to the high number of relevant calamitous events that happened during the 1960s, among which the most important were the flooding in Florence of 1966 and the Belice earthquake of 1968. Florence flood was especially significant, since it has been the first catastrophic event with worldwide media coverage – due to the enormous cultural and artistic heritage exposed – and can be considered one of the founding moments of Civil Protection volunteering.

In 1970, finally, the first law that directly referred to the Civil Protection passed. It was the law n.996 "*Norme sul soccorso e l'assistenza alle popolazioni colpite da calamità*" (Rules for people assistance and rescue in case of catastrophic event).

This norm, although it was still based on the sole concept of rescue and still treating calamitous event as exceptional happenings, represented the starting point for the definition of the actual organization of the Italian Civil Protection, and moved the service from the Ministry of Public Work to the Ministry of the Interior.

The law defined the Civil Protection as the whole set of activities needed for the arrangement of emergency management, rescue and people assistance services, as well as the coordination of all the different players involved in the activities during calamitous events. However, this norm was still too focused on the rescue activities rather than on the whole process that makes the modern system.

In 1980 a great earthquake hit the Irpinia region, with immense disruption and loss of human lives. The organization of the rescue operation was extremely problematic and the subsequential costs for reconstruction relevant.

After this further unsuccessful episode of management, with a Decree of the President of the Republic n. 66 of 1981, the execution regulation of the law n.996 of 1970 was adopted, with some important news: Civil Protection was defined as "primary competence of the State" and the role of local administrator, especially mayors, was formally restored, even if responsibility and competences were still not totally defined. This decree was partly shaped on the organizational model experienced with the Friuli earthquake (1976), which was an example of great emergency management and reconstruction and where the local administrations and population had a central role during the whole process. It was the first appearance of emergency planning, prefects were in fact supposed to draft provincial emergency plans, together with exercises organized by the Ministry of the Interior.

Finally, in 1982, the law n.938 formalized the figure of the Minister for Civil Protection coordination, inside the Ministry of the Interior, as well as a Civil Protection fund, in order to have the capacity of fast reaction in case of event. It was also established the Civil Protection Department, with responsibility for data collection for prevision and prevention of emergencies, drafting of national and local emergency plans, rescue coordination and promotion of voluntary work.

It is the beginning of the creation of an organic institutional structure, in charge of emergency management and planning, even though the organization was still to be improved and there was some superposition of competences between the Ministry of the Interior – with its prefects – and the new-born Civil Protection Department. Superposition of competences that has not been totally solved yet.

The whole decade of the 80s was characterised by the recognition from the

institutional authorities of the necessity to introduce new expertise in the mechanism, able not only to help in case of emergency but also to contribute to the construction of knowledge basis useful in the prevision and prevention phase. The "*Gruppo Nazionale di Vulcanologia*" (National Volcanology group), "*Gruppo Nazionale per la Difesa delle Catastrofi Idrogeologiche*" (Hydrogeological catastrophic event defense group), "*Gruppo Nazionale per la difesa dei terremoti*" (Earthquake defense group) and the Operational Emergency Centre were established. The institution of such groups is particularly relevant since it can be considered the ancestor of the Competence Centres, meaning that the importance of proper risk knowledge is starting to be recognized.

Today, the competence of these complementary groups is central in the organization of the Civil Protection Department and scientists and decision-makers work in close collaboration for effective Disaster Risk Reduction (Dolce, Di Bucci; 2022).

The operative period

The 1990s marked a change in the emergency and risk management, not only in Italy but also worldwide. In 1990 it was launched the "The International Decade for Natural Disaster Reduction" by the United Nations. In Italy, the "operative period" started, i.e., the moment in which the institutional form of the Civil Protection was defined and processes and practices of the Civil Protection system are strengthened.

In 1992, with the law n.225, the National Service of Civil Protection was definitely established.

Civil Protection is a public duty and a public service, which involved different institutions as well as the civic society. The institution of the Service is based on a clear normative framework and identification of competences, which involve not only emergency management but also prevision, prevention and response.

The inclusion of prevision, prevention and response phase represented a big step forward for risk culture in Italy, even though they were the less detailed part of the norm and remained under-funded. It was a first formal attempt to move from a rescue-oriented vision to proper Disaster Risk Reduction.

Not only the national level was included in the norm, but also the participation of lower territorial level was crucial: Regions, Provinces and Municipalities. The mayor becomes the local authority of Civil Protection. The law was based on the idea that the first response had to be guaranteed at the local level and that the mayor was in charge of it, even though the norm did not specify nor the tools or the modalities for this response to happen. In fact, the 225/1992 law do not oblige yet to draft emergency plans (Bignami and Menduni, 2021a).

Furthermore, the technical and operative national structures are defined: Fire Department, voluntary service, Army and Police service, public and private agency of national relevance, universities and research groups. The "Service formula" was representative of the fundamental setting of the Italian Civil Protection, which is composed by an organic coordination of competences and agencies normally devoted to other activities but able to collaborate in case of emergency.

Despite the modernity of the law, the resulting modernisation of the administrative and governmental process of Civil Protection still needed time.

The 1992 law was full of gaps and the management of the calamitous event that

stroke in the 90s – as for instance the floods of Liguria (1992-1993) or Piedmont (1996 – 70 casualties and over 10 000 people evacuated) – demonstrated all the deficiency of the action capacity of the Civil Protection System.

In order to try to answer to the need of a more structured process, in 1997 the so-called "Augustus Method" was developed, a directive stating guidelines for Civil Protection emergency planning at all the different territorial levels. The Augustus Method is still fundamental in Civil Protection planning. An in-depth description of the method can be found in paragraph *4.2 Emergency management and operational model: the Augustus Method*, where the genesis and the characteristics of the method will be discussed in more detail.

In general, the 1990s are characterized by an attempt to make emergency management more efficient. It is in these years that the first concrete efforts of large – scale intervention for Disaster Risk Reduction happened, together with the redaction of different guidelines and manuals.

However, once again, it was a catastrophe that boosted the development of the system, the hydrogeological tragical events of Sarno, Quindici, Bracigliano, Siano and San Felice a Cancello in Campania of 1998, which caused 168 deaths.

The need to enhance monitoring and warning capacity to facilitate risk reduction and preparedness for emergency management became evident. Laws were approved for the acceleration of basin planning and soil protection, and obligations were finally imposed to draft emergency plans for the municipalities most exposed to hydrogeological risk[2]. It is relevant to notice the central role that is covered by regions in the drafting of emergency plans. Regions are, in fact, in charge of the redaction of regional guidelines for planning, while the role of the State is absent – consistently with the aim of decentralisation of power of the norms (Bignami and Menduni, 2021). Then, funds for the strengthening of monitoring network were issued. This will lead to the definition of the programme for the construction of the Competence Centres, even if they will not be operative until 2004.

Another important milestone of that period for the definition of the modern Civil Protection is the law n. 3/2001 "*Modifiche al titolo V della parte seconda della Costituzione*" (Modification of the fifth title of the second part of the Constitution) in which for the first time the Constitutional Chapter expressly deals with Civil Protection issues, inserting them among the matters with concurrent legislation.

This means that, within a general framework of guidelines established by the State, the Regions have the right to build and regulate their regional Civil Protection systems (Dolce et al., 2020). It is of these years the change in the logo of the Civil Protection Department, as if it was the sign of the ongoing adjustment that the system was experiencing. The new logo displays the text "National Civil Protection", different in text and symbol to the one of the Regional Civil Protection. As it will be better explained in the following paragraphs, this division of competences and organization among the different territorial levels is a crucial point in the management of the Disaster Risk Reduction gaps.

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2 D.Lgs. 112/1998 "*Conferimento di funzioni e compiti amministrativi dello Stato alle regioni ed agli enti locali, in attuazione del capo I della legge 15/03/1997 n.59*" and Dl. 180/1998 "*Misure urgenti per la prevenzione del rischio idrogeologico ed a favore delle zone colpite da disastri franosi nella regione Campania*"

In 2012, a fresh reform of the National Civil Protection Service was initiated, the Law No. 100/2012. This law introduced significant modifications to the National Civil Protection Service, addressing crucial aspects that impact the entire system.

Central issues encompassed the classification of disaster events, Civil Protection activities, declaration of the state of emergency, and the authority to issue ordinances.

The legislation strategically redefined the initial phase of emergencies, prioritizing the temporal dimension. Extraordinary means and powers were to be utilized for delimited and pre-defined time-bound interventions.

Moreover, the law mandated the early identification of the competent administration responsible for continuing activities once the state of emergency lapsed.

This legislative framework aimed to enhance the efficiency and temporal precision of interventions in response to emergencies, underscoring a proactive and time-sensitive approach to Civil Protection activities (Dolce et al., 2020). Time is becoming a central matter in emergency management and the idea of continuity in the disaster cycle for effective Disaster Risk Reduction is starting to be included in norms and practices.

The second decade of the 2000s was marked by major catastrophic events, such as the earthquakes in Emilia Romagna (2012) and central Italy (2016), that foster the growing and development of some segments of the National Service: the alerting system of the functional centres, the world of the volunteering, the technical legislation on anti-seismic buildings, the introduction of technological innovation such as the use of Territorial Information Systems and the new fundamental functions related to emergency planning.

In order to organize in a systematic and organic way this great whole of norms, practices and tools, in 2018 with the Legislative Decree n.1/2018, the New Civil Protection Code is issued.

This is a collection of the multitude of material and norms that along the years have shaped and described the different functions that the Civil Protection was embodying. The Code is the normative basis of the actual Civil Protection Service, product of years of legislative layering and expression of socio-political and institutional transformation that affected the nation as consequence of the various catastrophic events that happened along the years (Bignami & Menduni, 2021a).

As a conclusion, it is interesting to highlight two critical issues that emerge from this brief reconstruction of the evolution of the Civil Protection system.

The first is represented by the subdivision of roles between National Civil Protection and Regional one. While from a normative perspective, the competences of the two are well defined, we will see in the next paragraph how the border of allocation of competences is often blurred, paying the criticalities of operating in a federal way, in an institutional organization which is not federal (Alexander, 2018).

Then, laws and norms have always followed catastrophic events, never being able to prevent and mitigate risk. This kind of approach is typical of emergency management operations, and it is deeply rooted also in everyday practice of Civil Protection.

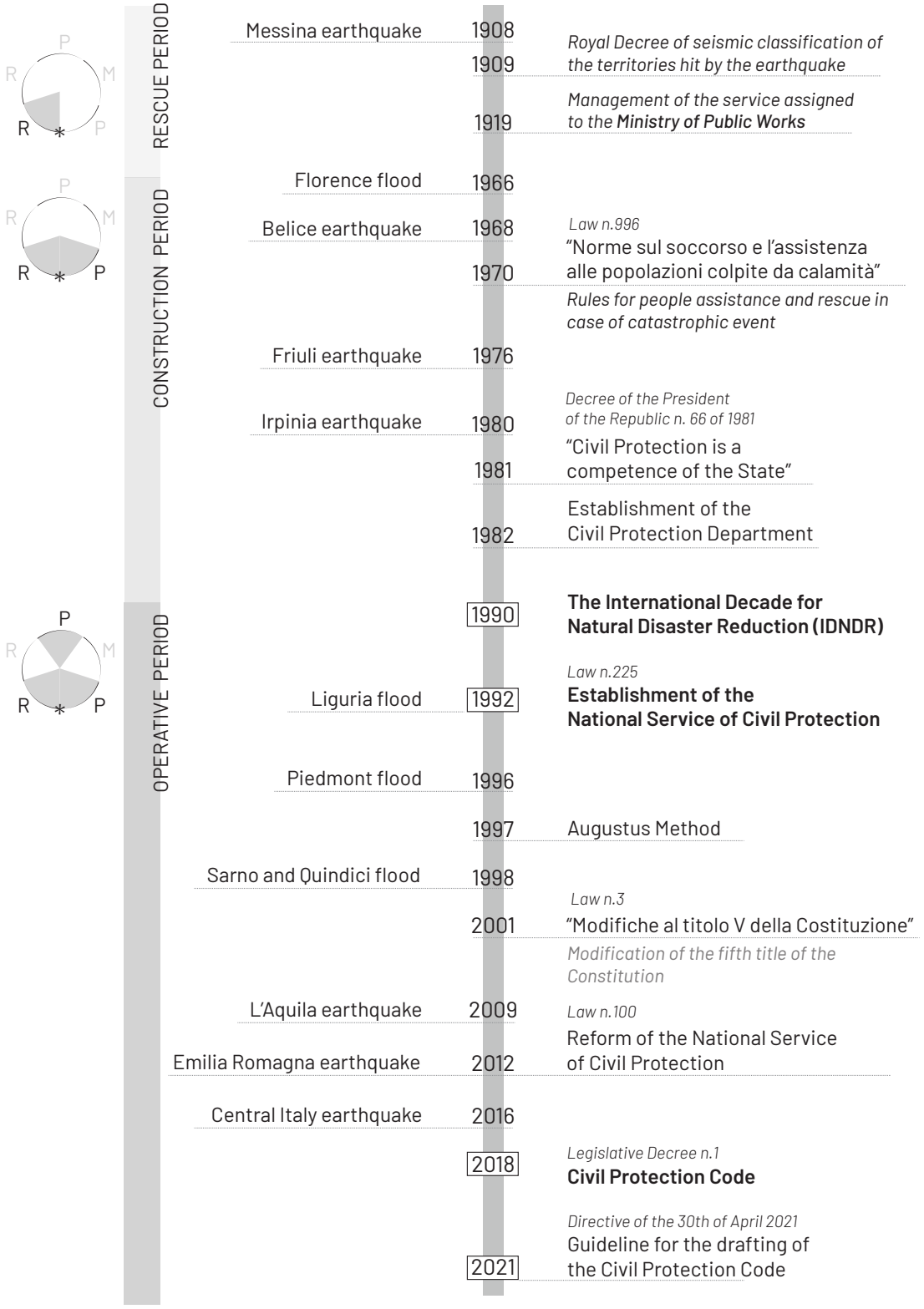

Figure 8. Evolution of the Italian Civil Protection normative system in relation with the specific phases of the disaster cycle addresses as well as the major disastrous events of the XXI century. Source: Author's elaboration based on the information of Bignami (2010).

4.2 Emergency management and operational model: the Augustus Method

As introduced in the previous paragraph, in the 1990s the need to define in a more structured way the methodologies for Civil Protection planning arose. Hence, the Augustus Method was developed, with the aim of providing a framework for defining, elaborating, managing, verifying, and updating Civil Protection emergency plans.

Although today the structure of Civil Protection planning is defined by the Civil Protection Code and the Plan Directive, it is still worthwhile to analyse this method as it represents the genesis of the modern intervention model. The system structured into operational rooms and support functions is still in use, and the study of this method has been essential in understanding the activities and operations observed during the *EXE Sisma dello Stretto* exercise.

The Augustus Method was first published by Elvezio Galanti, Coordinator of the Planning and Training Activities Service of the Department of Civil Protection, in May-June 1997, in the magazine "*DPC Informa*," an informative periodical of the Department of Civil Protection, Year II - Number 4.

The name is given evoking one of the reflections attributed to the Roman emperor Augustus: "*The value of planning decreases with the complexity of things*." This is meant to convey the impossibility to detail every single part of emergency management, as its nature is inherently unpredictable.

However, what is possible – and necessary – is to provide methodological foundations for managing the complexity of calamitous phenomena, without oversimplification, but rather through the division of responsibilities and the construction of collaboration models.

The aim of the working group in charge for the development of the guidelines of the Method was to provide mayors and prefects with a flexible emergency planning framework that could adapt to local risk scenarios and clearly delineate a simple working method for identifying and activating procedures to effectively coordinate Civil Protection responses.

The Augustus method can be considered as the "*immaterial infrastructure*" (Bignami, 2010, p.211) for implementing emergency planning activities, with particular reference to organizational forms, decision-making processes, operator accountability, involvement of technical-scientific expertise, and operational forces.

As highlighted by Bertin (2014), two are the interesting issues related to the Method: its ability to break down the problem into necessary resolution functions and its collaborative structure. The Method, in fact, introduces in Civil Protection planning support functions and the definition of the model of intervention.

The support functions represent the basic organization of each coordination centre at all territorial levels (municipal, optimal context, provincial, regional, national) and are defined as specific areas of activity, functional to guarantee the choral management of the emergency context (Dolce et al, 2020).

They are fourteen for the provincial coordination centre (P) and nine for the

municipal ones (M):

1. *Technical function and Planning* (P-M): it maintains and coordinates all relationships between various scientific and technical components for the physical interpretation of the phenomenon and data related to monitoring networks.
2. *Health, Social Assistance, and Veterinary* (P-M): it coordinates the Red Cross, local health service, and volunteer organizations operating in the sector.
3. *Mass Media and Information* (P): it defines methods and meetings with journalists and mass media, as well as the dissemination of news related to the event (in case of emergency) and information about the plan and risk management in general.
4. *Volunteering* (P-M): it coordinates local volunteer groups and organises training and peace-time exercises;
5. *Resources and equipment* (P-M): it assesses the material, resources and equipment available to the administration;
6. *Transportation and mobility* (P): It is dedicated to the handling of materials, the transfer of resources, and the optimization of flows towards escape routes. It must work closely with the responsible for Function 10 – Search and Rescue operational structure;
7. *Telecommunication* (P-M): it is dedicated to the arrangement of an alternative communication infrastructure, especially in case of major disastrous event;
8. *Primary services* (P-M): it is dedicated to the maintenance and restoration of the primary services of the area, including for instance electricity, waste collection, water distribution or school system;
9. *People or property damage assessment* (P-M): It is responsible for assessing damages to individuals, public and private property, industrial facilities, essential services, etc., with the assistance of professionals, technical offices, and volunteers.
10. *Search and rescue operational structure* (P-M): it coordinated the different operational structures (Army, fire department, National technical services, Health national services etc);
11. *Local Authorities* (P): It is the function that coordinates the lower-level territorial entities (municipalities);
12. *Dangerous material* (P): It manages the storage of hazardous materials and the inventory of industrial facilities at risk;
13. *People assistance* (P-M): it helps the population in need during the event, providing with primary services as hospitality or food;
14. *Operational centres coordination* (P): it is the function that is in charge of the management of the control room and of the coordination of the 14 support functions.

There are two objectives to achieve: i) ensuring rapid availability of resources for each support function in case of need and ii) assigning each function a responsible individual, in charge of overseeing operationality during emergencies, updating the relevant data within the comprehensive emergency plan during non-emergency phases, and implementing lessons learned from exercises or events.

This organization is an attempt to involve multiple actors in the Civil Protection

plan and, at the same time, to ensure its diffusion during peacetime. This division of responsibility is thought for making the plan fully embraced by those who will have to manage it in case of event, even if the drafting of the plan is commissioned externally (Bignami, 2010). Indeed, the issue of knowledge and assimilation of the Civil Protection plan by the actors who will manage it has always been central.

The Augustus method is the first in a series of attempts to overcome the compilative and bureaucratized conception of the Civil Protection plan. We will see in the following paragraphs how the new Civil Protection Code also seeks to address this issue through the introduction and formalization of participatory planning and community engagement.

4.3 The Civil Protection Code and the Plans Directive

The Legislative Decree No.1 of the 2nd of January 2018, the "Civil Protection Code", aims at unifying and simplifying all the different Civil Protection norms and regulations that have layered over the years, grouping them in one clean text. Both form and substance of the norm make explicit the objective of simplification, the Code is, in fact, easy to read and compare with previous laws. In every article, there is an indication of the norms that have been substituted, and in the last two articles there is a summary of the different normative references as well as the complete list of all the laws that have been revoked.

Regarding the substance, the Code emphasizes a polycentric model for the National Service, which seeks to guarantee a linear, prompt and efficient operativity in all the different phases of the disaster cycle in which the Civil Protection acts as player. With this Code, roles and competences regarding the public scope of Civil Protection reach maturity, particularly concerning the role of mayors, municipalities and planning at the local level (Bignami & Menduni, 2021b).

Some years after the publication of the Code, the Directive of the 30th of April 2021 – Guidelines for the drafting of Civil Protection plans (from now on, called "Plan Directive") was issued. This "Plan Directive" was introduced with the aim of coordinating the components and the drafting of Civil Protection plans on a national basis, as well as the integration of all the different systems at the different scales. With the Code and the following Directive, a certain level of legislative maturity has been reached. However, this is not to be considered as an ending, but rather as a starting point for a collective and public effort on which the Disaster Risk Reduction community should focus (Bignami & Menduni, 2021b).

There are different changes in the new Code.

Some of the changes concern the foundation of the Service, while others regard some technicalities related to the administrative organizations.

As for the first group, an exhaustive list of the activities included in the Civil Protection competences is made, comprehending prevision, prevention and risk

mitigation in the discourse. The analysis of dynamic risk scenario is included in the prevision phase, while structural and non-structural interventions are included in the prevention one.

According to the Code, structural activities include the execution of risk mitigation interventions in occasion of calamitous event as well as the participation in the implementation of national and regional guidelines for the definition of policies. On the other hand, non-structural interventions concern first of all the totality of the activities planning-related, then the training and the acquisition of competence risk-related and the diffusion of risk-knowledge and culture. The updating of norms and the exercise activities are part as well of the non-structural intervention.

The inclusion of elements such as risk knowledge diffusion in the group of risk prevention measures proves the complete embodiment of the Civil Protection Service in its role as a player throughput the entire disaster cycle, not only bounded in the emergency response phase. Furthermore, it represents the formal recognition of the importance of integrated actions for effective Disaster Risk Reduction.

Another fundamental issue highlighted in the Code is Civil Protection planning, that for the first time is the central topic of a norm.

There is an evident attempt to deeply transform the nature of the plan, overcoming the "passive compilation" of the document, in favour of an evolved vision that seeks to make the plan fully operational, with a strong and participated soul. An attempt in this direction had also been made with the definition of the Augustus Method, which is based on the same principles, but which had never managed to establish itself at a legislative level (Bignami & Menduni, 2021b).

Furthermore, in the Plan Directive, there is another attempt of modernization. Article 7 of the technical annex deals with the topic of coordination of Civil Protection planning with urban and territorial planning. Details of this article will be given in paragraph *4.5 Civil Protection Emergency planning*, where the topic will be deepened, also in relation with other Italian instruments and norms related to spatial planning.

A further central topic introduced by the new norm is the concept of the "*digital plan*", which appears in the technical annex of the Plan Directive.

The "new" Civil Protection plan is in fact conceived as a natively digital tool, built with standards that guarantee uniformity and interoperability of data at a national level, so as to facilitate access, management and consultation of information for all the different subjects involved in the Civil Protection Service. Final aim is the implementation of a national integrated IT platform, called the "National Catalogue of Civil Protection Plans", capable of exchanging data with the Regional information systems and thus creating a virtual place for comparison and interaction between the various plan components, from the planning aspects to the procedural ones.

The intended objective of the Catalogue is to contain the whole set of Civil Protection plans at the different territorial levels, to ease information exchange and data sharing, in order to ensure coherence of planning instruments at multiple

scales, all over national territory.

An attempt to start the collection of digital information had already been made with the Directive of the Presidency of the Council of Ministry of the 14th of February 2014, the "National Seismic Risk Rescue Programme".

In that text reference is made to the possibility for the Civil Protection Department to request data that are:

"geo-referenced and compatible with the most common GIS platforms; they must also be accompanied by the relevant metadata describing their properties and characteristics, drawn up in a manner that complies with the standards laid down[...], so that they can be organised within the Civil Protection Department's Geographical Information System"

("[dati] georiferiti e compatibili con le più comuni piattaforme GIS; gli stessi dovranno essere, inoltre, corredati dai relativi metadati, che ne descrivano le proprietà e le caratteristiche, redatti in maniera conforme agli standard previste[…], in modo da essere organizzati nell'ambito del Sistema Informativo Territoriale del Dipartimento della Protezione Civile").

In comparison with this directive, the developments of the Plan Directive focus on the effort in the drafting of national standards in order to build the Plan Catalogue, which will help Administrations in organizing data coherently on a national basis. The document of the "Operational indications concerning the informative organization of territorial data necessary for the implementation of a nationally integrated computer platform called "National Catalogue of Civil Protection Plans" was issued on January 2024[1].

The plan catalogue and the standardisation of information at national level is certainly an important step towards the factual implementation of the digital transition at national level. However, at the moment, the greatest challenge is the various level of digitalization of the different Italian Regions, as well as the reluctance of many local administrators to embrace the digital transition of planning tools for their territories.

1 Directive of the Presidency of the Council of Ministry of the 29th of January 2024 "*Operational indications concerning the informative organization of territorial data necessary for the implementation of a nationally integrated computer platform called "National Catalogue of Civil Protection Plans*".

4.4 The organization of the National Civil Protection Service

. The actual organization of the National Civil Protection Service is regulated by the Civil Protection Code and it is composed by a plurality on institutional and non-institutional actors, which operates under the national coordination of the Civil Protection Department of the Presidency of the Council of Ministry. The responsibility of Civil Protection is not delegated to a singular administration; instead, it is a function ascribed to an entire complex system that operates in accordance with the principle of subsidiarity, differentiation and adequacy (Dolce et al., 2020).

Vertical subsidiarity requires that public functions are implemented by the administrative level closest to citizens, and that the territorially higher level intervenes only when the lower level is not able to undertake properly the task. National Civil Protection Service operates at local, regional and central level; 3therefore, it can be defined a multi-level and multi-scale coordination system.

At the national level, it is the President of the Council of Ministers that determines civil protection policies, through the Civil Protection Department, which coordinates the national service. The Department is responsible for major emergency situation, for the drafting and implementation of national plans and national relief programmes - as well as guidelines and norms of national relevance - for the direction of training activities and exercises, for the promotion of scientific research concerning risk prevention and mitigation and for the participation to the European Union's Mechanism.

At the local level, Civil Protection authorities are represented by the Presidents of the Regions and the Autonomous Provinces of Trento and Bolzano as well as by the mayors.

Being Civil Protection a subject of concurrent legislation[1], each Region has enacted specific measures and regulations on the subject, according to national directive and the Civil Protection Code. Generally, these norms concern:

- The definition of regional, provincial and local strategic and operational structures, such as the *DICOMAC - Direzione Comando e Controllo* (Command and Control Centre) or *CCS – Centro di Coordinamento Soccorsi* (Rescue Coordination Centre);
- The definition of duty and competence of the different actors involved in emergency management, including ordinances, regional crisis status and derogation from regional norms;
- Guidelines for emergency planning and prevision and prevention planning.
- Guidance for accessing eventual economic contribution for the drafting of Civil Protection planning instruments.
- Coordination with research centres and monitoring structures.
- Training activities and voluntary coordination.

1 See paragraph 5.2 The Evolution of the Italian Civil Protection System, regarding the law n. 3/2001 "Modifiche al titolo V della parte seconda della Costituzione" (Modification of the fifth title of the second part of the Constitution).

In order to define coordinated model of intervention and to simplify the complexity of the subject, there are occasion in which the Civil Protection Department has undergone agreements with the local authorities. These agreements aim at ensuring the effectiveness of the coordinated response to a variety of catastrophic events, which for intensity and extension might need the coordination of a higher authority (Bignami, 2010).

An example of this is the case of the participatory planning analysed in the next sections of the work, where the Department of Civil Protection – therefore national level – promotes the coordination of a project for the municipality of Bagnara Calabra (RC), in order to explore innovative planning methodology and implement examples of good practices at the local level. As it will be better discussed in the dedicated chapter (*Chapter 6: Case study analysis*), the coordination between the national and the local level is not straightforward, especially because competences of the territorial levels in-between might overlap (Alexander, 2018).

Another significant figure is the one of the prefect. The prefect performs the function of representing the Government on the territory, on events that involve the area of their competence take on the unitary direction of emergency services in liaison with the President of the Region, in particular by ensuring and coordinating the intervention of the State structures present in the provincial territory (Dolce et al., 2020). With the definition of the optimal context the role of the prefect become of less relevance, showing overlapping competences.

The National Service is structure in components, national and regional operational structures and contributing subjects (Civil Protection Code, art.3) (Figure 9). The State, Regions and autonomous Province, as well as local authorities are part of the Components, while the Operating Structure consist in firefighters, armed forces, police forces, the scientific community, the national health service, the Civil Protection Voluntary service and the national system for environmental protection.

Finally, professional orders, technical practitioners and certain private and public companies (as for instance utilities companies) are Contributing Subject, as their activities might be useful for civil protection purpose. One example of this is the work conducted by architects, engineers and others technical figures is the aftermath of an earthquake, for the definition of the usability of buildings.

Figure 9. Organization of the National Civil Protection Service
Source: Author's elaboration

4.5 Civil Protection planning

The history of Civil Protection planning is relatively short, as it is just in the 1990s that the importance of the instrument begun to emerge. With the Law No. 225/92 the central role played by the mayor in the first response to emergencies was defined but the law did not yet indicate any obligation to draft municipal Civil Protection plans. This obligation occurred only with the legislative decree No. 112/98, issued in consequence of the Sarno hydrogeological catastrophic event. Regions were in charge for the definition of directives and guidelines for the drafting of these plans, without any kind of central coordination and therefore not considering the need for national standards. In that years, the initial need for a standardized method is emerging, as it is demonstrated by the development of the Augustus Method.

From 1998, Civil Protection planning became to be increasingly structured. Despite the recognition of the need for uniformity on a national basis over the action of the local Civil Protection, the subject was still based on a model that sees the Regions as the main institution in charge of the enactment of the planning criteria (Bignami & Menduni, 2021b).

The Civil Protection Code of 2018, and especially the subsequent Planning Directive of 2021, marks an important step for Civil Protection planning in terms of its standardisation at national level and the recognition of its role as a primary emergency management instrument. The Civil Protection plan acquires strength and significance, while the role of the mayor is delineated and proceduralized with the objective – and hope – of transcending the mere compilation concept of the plan and ultimately transforming it into a political, effective, and participatory tool (Bignami & Menduni, 2021b).

In general, the aim of emergency planning is to minimize as much as possible the likelihood that the onset of a calamitous event leads to a situation of disaster, of ungovernability. Therefore, emergency planning is in charge of the management of the evolution of the urban and territorial system, supporting the evolution of the events, from the beginning of the emergency to the securing of the population. Emergency plan is an organizational tool, based on the concept of management, coordination and optimization of the available resources (Bertin, 2018).

This operational soul of the emergency plan is confirmed by the art. 18 of the Civil Protection Code, that defines Civil Protection planning as the non-structural prevention activity, based on the prevision and definition of risk scenarios, aimed at the determination of operational strategies and the intervention model in case of a calamitous event. Civil Protection planning is a system activity, that must be undertaken jointly by all the administrations at the different territorial levels, according to the principles of subsidiarity, differentiation and adequacy.

According to the Code, there are five territorial levels of planning:

- National
- Regional

- Provincial/Metropolitan City
- Optimal context
- Municipal.

National-level planning concerns specific risk scenarios of particular magnitude, requiring the mobilisation of the entire national Civil Protection service. Civil Protection Department is in charge for the drafting, the coordination and the implementation of national plans.

At the regional level, it is the Region the administrative entity in charge for the drafting of the regional Civil Protection plan, that defines coordination and rescue activity of the regional Civil Protection structures.

At the provincial and Municipal level, the Region drafts the plan in accordance with the Prefetture (territorial governmental offices), following regional guidelines. There might be the case of the overlapping of provincial planning with optimal context one, in order to simplify the process.

The concept of the "optimal context" (*ambito*) is new to the Civil Protection organization as it was introduced with the Code of 2018. The optimal territorial and organisational context can be defined as the group of municipalities that cooperate on risk reduction and for which activities can be carried out jointly.

According to the Code, the territorial subdivision of the optimal context must be agreed at regional level, considering socio-economic and demographic criteria, as well as zones of attention and risk scenario[1]. The definition of Civil Protection planning at the optimal context level is also entrusted to the Region and must identify the resources available in order to guarantee the optimisation of their use during emergencies, also identifying how to support the municipalities. Optimal context plan is an integral – and sometimes coincidental - part of provincial level planning.

The introduction of the optimal context concept demonstrates an attempt by the Civil Protection system to foster the improvement of multilevel governance capabilities and, at the same time, to foster cooperation between contiguous areas.

Being risk something that rarely respects administrative boundaries, the inter-municipality coordination in the activities of risk management is particularly relevant (Presidenza del Consiglio dei Ministri - Dipartimento della Protezione Civile, 2022).

However, the addition of a further planning level, in many cases not dissimilar to the provincial one, may represent a complication for several territorial realities, especially in a scenario of limited economic and human resources. An example of

1 The Civil Protection Department, within the framework of the PON Governance 2014-2020 project (Presidenza del Consiglio dei Ministri - Dipartimento della Protezione Civile, 2022), developed a methodology for the identification of territorial contexts, which is useful for regional administration for the definition of the optimal context (*Ambiti*).
This methodology ensures the replicability and objectivity of the process but is not mandatory for the Regions. In any case, a series of criteria must be met a) the areas must be located within the provincial administrative boundaries, b) the municipalities that perform the Civil Protection Service in an associated manner must fall within the same area, c) the territories of the municipalities within the same area must be contiguous.

this was made clear during one of the interviews conducted with a Civil Protection official of the Calabria Region, who pointed out that the Region was trying to make the organisation of the optimal context coincide with the provinces, so as not to disrupt the organisation at regional level, especially in the face of a lack of funding for reorganisation.

In light of this, the attempt to overcome administrative boundaries for integrated coordination of non-structural risk reduction activities appears to be extremely interesting, but at the same time, the impact of introducing a new instrument into an already overloaded system must not be underestimated.

According to the Plan Directive, which contains the detailed description of the different elements of the Civil Protection plans, regardless of the specific territorial level, each plan must include:

- The *introduction*, with the date of approval and updating and the overview of the contents of the document.
- The *territorial framework*, containing administrative borders and demographic characteristics, morphological description of the territory, climate regime, urban systems, infrastructural system, main risk affecting the region and presence of relevant spatial planning instruments (urban master plans, landscape plans, hydrogeological structure plan).
- The *hazard and risk scenario*, composed by cartography, description of the event and evaluation of the expected damage on human beings, assets, urban systems, animals and environment.
- The *model of intervention*, the organization of the Civil Protection Service, the strategic elements and the procedures.

The last point of the above-mentioned list plays a relevant role for the completeness of the instrument. Civil protection planning is, in fact, a highly operational activity, and often the procedural component outweighs the spatial one, especially for Civil Protection practitioners[2].

However, the embodiment of the operational procedures and strategic activities of the Civil Protection plan might represent an obstacle for non-experts, being an operation that contains technical elements and that – in order to be effective for disaster risk reduction – needs to be undertaken not only in emergency time but along all the different phases of the disaster cycle (Alexander, 2002).

Starting from the recognition of this needs, one of the possible solutions introduced in the article 18th of the Civil Protection Code is represented by the inclusion of the participation of citizens in the drafting process of Civil Protection planning, in an attempt to make local administrator and the community fully aware of their instruments.

The Plan Directive details the means for this participatory process, making a clear distinction among public communication, public consultation and public

2 The relationship between the procedural component and the spatial component of the Civil Protection plan will be discussed in detail in the conclusion of this dissertation, *Part III - Planning effectively for Disaster Risk Reduction,* as the relationship between these two aspects encompasses one of the challenges in the difficult integration between Civil Protection planning and ordinary planning.

participation. As for the first, public communication is intended as the unidirectional activity of information of the community made by the administration, in which people are not able to give any sort of contribution or opinion.

Citizens' opinions are considered in public consultation, which is a decision - making process led by the administration that, however, does not allow dialogue between the actors involved.

Finally, public participation is intended as the process of community involvement that includes dialogue with the administration responsible for planning and which, usually, produces changes in the views of the parties and thus in the plan documents. Therefore, according to the Plan Directive, citizens must be active elements in the drafting process of Civil Protection planning, using different methodologies and according to the strategic objectives designed for the activity.

These indications seem to suggest an attempt to move towards a people-centred approach, in which the population plays an active role and knowledge is co-created by the various actors included in the process (Scolobig et al., 2015), while continuing to maintain a top-down setting, in which the initiative and the definition of the project's modalities remain the responsibility of the administration in charge.

4.5.1 The integration of Civil Protection planning with the Italian spatial planning system

Article 18th, paragraph 3 of the Civil Protection Code says that

"The plans and programs for the management and protection and restoration of the territory and other areas of territorial strategic planning must be coordinated with the Civil Protection plans in order to ensure consistency with the risk scenarios and the operational strategies contained therein".

The topic of the integration between Civil Protection planning and ordinary planning in Italy has never been addressed from a regulatory point of view and remains an unsolved issue . The inclusion of this statement in the Civil Protection Code certainly represents an initial attempt for the beginning of the process of integration, even if it still appears as incomplete.

An interesting analysis of this statement is made by Ioannilli (2020). The author stresses the fact that the relationship of Civil Protection planning with territorial governance has never been addressed in a framework of positive law. The statement concerning the "coordination" of Civil Protection plans with plans and programs for the management and protection and restoration of the territory and other areas of territorial strategic planning is incomplete and weak for the resolution of such a complex issue.

This proposition is merely formal in nature, as it does not provide consequences for non-compliance and, moreover, does not place any obligation on Regions to introduce specific provisions on the subject in their regional regulations related to territorial governance. Furthermore, the norm does not make specific reference to the different regional planning regulations, but rather refers to a generic "management and protection and restoration of the territory and other areas of territorial strategic

planning", thereby effectively excluding urban planning.

In addition, "coordination" appears weak as it lacks defined the direction: the norm does not clarify the elements of the Civil Protection plan that should constitute a reference framework for spatial planning and territorial governance instruments, nor does it specify the ways in which new planning choices can affect Civil Protection plans. More precise guidance on the subject can be found in some regional laws, demonstrating once again how the resolution of such complex issue is not faced at a national level but rather it is designated to local initiatives.

However, despite this uncertainty, there are many possible connections between Civil Protection planning and ordinary spatial planning.

A first point of connection is found in the knowledge phase of drafting plans, since for both Civil Protection planning and territorial and urban planning the issue of spatialised knowledge plays a central role, both in the construction of the territorial framework and in the definition of risk scenarios.

According to the Civil Protection Code, a risk scenario is an integrated product composed by a descriptive part and an evaluative part, supported by cartography and it concerns prevision activities, fundamental both for early warning and planning. It is considered a dynamic and evolutive activity. The risks considered are those taken into account by the Civil Protection service: seismic, volcanic, hydraulic, hydrogeological, adverse weather phenomena, water deficit and forest fires.

The contribution of ordinary planning to the definition of risk scenarios could be valuable in identifying exposed and vulnerable elements, taking into account not only their punctual location but rather the relationships and interactions of territorial systems and historical, urban and environmental elements (Galderisi, 2020). A relevant contribution to this integration could then also be provided by the digitisation of the territorial knowledge resulting from the risk scenario analysis and evaluation Through the creation of comprehensive territorial information systems, this could facilitate the dynamic updating and sharing of territorial information (Menoni, 2020)[1].

Furthermore, the Plan Directive explicitly refersto the possibility, for certain types of risk and certain scales, of using hazard scenarios drawn up by other sectorial plans, such as those of hydrogeological structural planning. Despite the fact that those enlisted above represent valuable possibility, they still do not solve the issue, but rather paves the way for new areas of indeterminacy, since, as to date, the definition of risk scenarios in Civil Protection plans cannot lead to the imposition of specific constraints capable of conditioning planning choices. Such coordination choices should therefore be guided by a precautionary principle, but once again deferring the solution of the problem to the willingness of local administrators (Ioannilli, 2020).

Another viable area of connection between those two faces of planning might be found in the design phase of the planning instruments, by the conjunct identification of strategic areas and infrastructures.

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1 It is in this direction that points the implementation of the National Catalogue of Civil Protection Plans.

Civil Protection plans must identify a set of strategic assets (buildings, structures, infrastructures and areas) that must be considered as invariant in urban and territorial planning.

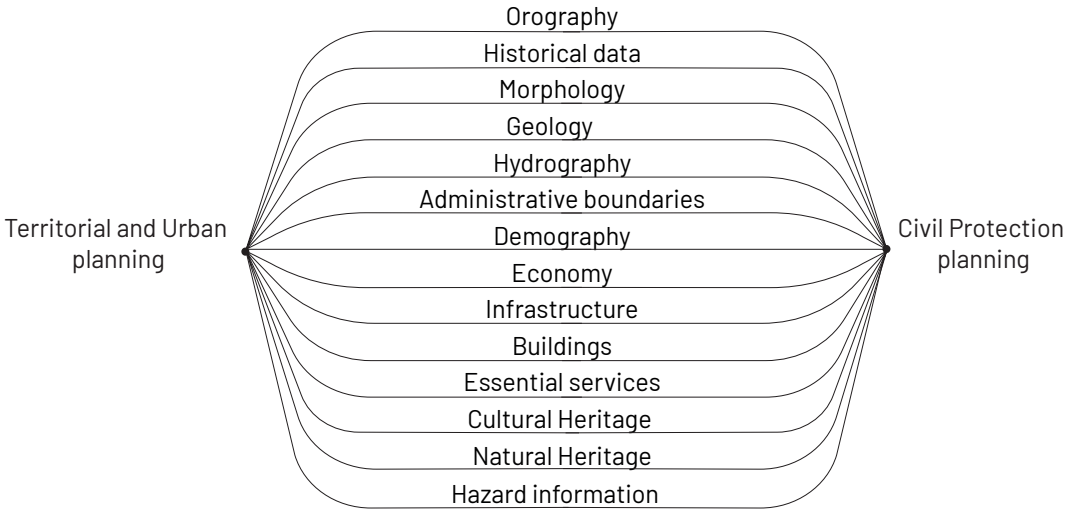

Figure 10. Shared element of spatialised knowledge between Civil Protection planning and territorial and urban planning
Source: Author's elaboration

Likewise, urban and territorial planning must incorporate the provisions of Civil Protection plans and provide for the use and maintenance of the structures identified in accordance with their purpose. As it is today, the relationship between the two instruments is a mere mutual recognition; however, the localization of strategic areas and assets could represent a relevant cooperation field, in order to start a process of territorial analysis not anymore focused on the single location of the assets, but rather on their systems, in a strategic and dynamic perspective, embracing a multipurpose approach (Galderisi, 2020; Ioannilli, 2020).

Such logic proves to be central when considering climate change adaptation strategies, demonstrating how adopting such a perspective could generally benefit risk reduction. For effective risk reduction of an urban system, intervention strategies must comprehensively understand the urban organism, not merely as a sum of individual functions but as a complex system, moving from engineering considerations to urban planning ones.

One of the instruments in the field of urban planning that seeks to address this need is the one of the MUS - Minimum Urban Structure, used for seismic risk reduction purpose. The MUS represents a conceptual category within territorial governance and fits within the framework of urban planning tools (Fabietti, 2013).

According to the definition of the "Linee Guida per la definizione della Struttura Urbana Minima nei PRG" (Guidelines for the definition of the Minimum Urban Structure in the urban master plan) (Fazzio et al, 2010), the MUS is composed by the system of paths, spaces, urban functions, and strategic buildings for urban response to seismic events in emergency phases, and for the maintenance and recovery of ordinary urban activities, socio-economic functions, and relationships in the subsequent phase following the seismic event. It represents the essential resistant structure of the urban system in case of earthquake. It can be considered both analytical tool and planning instrument: it analyses and interprets the present condition, but, at the same time, it considers the elements designed by the planning tools. Indeed, it is dimensioned and organized foreseeing the improvement or enhancement of functionalities. (Di Salvo et al, 2013).

From a regulatory perspective, the MUS is described in the regional urban planning law LR n.11/2005 of the Umbria Region, which mandates the incorporation of the Minimum Urban Structure into urban master plan, thus demonstrating an innovative attempt to implement a (seismic) risk mitigation practice within an ordinary planning instrument.

Due to its characteristics, the MUS has been considered a potential point of connection between ordinary urban planning and Civil Protection planning, through its possible analogy with the tool of the LEC – Limit Emergency Condition, element concerning the intervention model for seismic risk in civil protection plans (Fabietti, 2013; Ioannilli, 2013; Olivieri, 2013).

The LEC - Limit Emergency Condition of an urban settlements is defined as the condition where, following an earthquake, despite concurrent physical and functional damages that disrupt nearly all urban functions, the settlement can still maintain, as a whole, the operability of most strategic functions for emergency response, their accessibility, and their connection to the territorial context. Therefore, the analysis of the LEC implies:

1. The definition of strategic building and areas that assure emergency response,
2. The definition of accessibility and connection infrastructure that allow to reach strategic buildings and areas, critical elements and the general territorial context.
3. The identification of structural aggregates and individual structural units that may interfere with accessibility infrastructures and connections with the territorial context.

The LEC thus emerges as a tool for assessing the conditions of the emergency management system as represented in the Civil Protection plan regarding seismic events. However, simultaneously, it may have implications for ordinary urban planning, particularly in light of its complementarity and similarities with the Minimum Urban Structure tool (Gruppo di lavoro per l'analisi della CLE, 2013).

However, it is critical to analyze both similarities and differences between the two instruments to avoid the simple equation that considers the Limit Emergency Condition a subset of the Minimum Urban Structure. Instead, they should be seen as two thresholds of the urban system's capacity (Olivieri, 2013).

The LEC does not originate as an urban planning category, nor does it possess design potentialities. However, it can represent a first attempt to introduce a systemic and spatialized perspective into Civil Protection plans, capable of starting an initial acknowledgment of urban complexity, overcoming the tendency of Civil Protection officers to consider the territory as a neutral, non-evolving support for organizing rescue (Fabietti, 2013).

While MUS and LEC may thus represent an interesting field of contact and a useful approach to the issue, they should not be regarded as definitive solutions, especially considering that both instruments are designed to address urban resistance to seismic events and are therefore not capable of responding to other risk condition.

4.6 Civil Protection exercise

Among the activities that are considered relevant for the understanding of the mechanism of emergency management and the functioning of the Civil Protection system, there is the one of Civil Protection exercises, which has indeed been chosen as case study.

Exercises are, in fact, an important instrument of knowledge and control over Civil Protection planning and procedures, as well as being indicated as non-structural risk reduction intervention. They permit to keep up-to-date the adequacy of the resources deployed as well as the territorial knowledge (Bignami, 2010). Furthermore, the exercise moment represents a significant opportunity to observe the functionality of the Civil Protection apparatus and the balance of tasks and competencies that emerge among the diverse participants.

According to the Plan Directive, Civil Protection exercises have the purpose of verifying the information contained in the Civil Protection plans at different territorial level, testing the efficiency of procedure and intervention models as well as helping in the diffusion and communication of the contents of plan to all the different stakeholders involved, especially civil society[1]. There are different classes of exercise, depending on the territorial level involved, the type of event simulated and the activities conducted (Table 2 and Table 3).

Not only the exercise itself, but also the preparation of it, is an important training moment. This means that all the preparatory phases preceding the exercise moment are part of the activity: training of the players involved, preparatory meeting between the different operational structures, strategic building inspection and verification of Civil Protection planning at the different territorial levels. Together with the preliminary activities, also the implementation of results at the local levels belongs

1 *Punto5. Le esercitazioni di protezione civile: "le esercitazioni di protezione civile hanno lo scopo di verificare quanto riportato nella pianificazione di protezione civile ai vari livelli territoriali, di testare la validità dei modelli organizzativi e di intervento, nonché di favorire la diffusione della conoscenza dei contenuti dei piani da parte di tutti i soggetti coinvolti, in particolare della popolazione"*

to the tasks involved in the exercise.

The complete description of the activities is found in the official executive document of the exercise, which include as well the reference scenario, bodies and administrations involved, the objective of the exercise and the time schedule.

The organization of a Civil Protection exercise is a multi-scale and multi-actor activity, that needs the coordination of a great number of different bodies, belonging to various entities and administrations.

The exercise process is developed according to an ordered sequence of activities:

- *The design phase,* when the exercise is planned, the aim is established and the people and bodies in charge are defined. Moreover, it is in this phase when the type of exercise is decided, including the reference Civil Protection planning at the different territorial level;
- *The planning phase*, when happens the factual implementation of the design phase. The executive document is written and the bodies and actors in charge are involved. Training starts, as well as the other preliminary activities scheduled;
- *The execution phase*, when the disastrous event is simulated and all the different activities planned are conducted;
- *The evaluation phase*, carried out both by internal (actors involved in first person, with different roles, in the execution of the exercise) and external subjects (actors which belong to the Civil Protection organization, do not take firsthand part in the activities but participate as evaluator). The evaluation phase usually comprehends those fields: coordination, operational activities and specific objective of the exercise;
- *The implementation phase*, that conclude the exercise cycle. This phase involves the implementation of the results of the exercise at the different territorial level. According to the results of the interviews with the evaluation group of the *EXE Sisma dello Stretto*, this is the most controversial phase of the process, as it is rather difficult to trace the actual implementation of the results at the local level, especially for those intervention which are not directly competence of the Civil Protection Department.

Based on territorial scale, type of event and players involved	
International exercise	• It involves from the national to the local level of components and operational structures of the Civil Protection department; • It is organised in the framework of European project or cross-border agreements; • It is planned by the Civil Protection Department as well as by Regions or Autonomous Province.
National exercise	• It involves the national Civil Protection Service on the basis of event scenario of national importance; • It provides for the verification of prevention and response plans, directions and measures; • It is planned by the Civil Protection Department, in accordance with regions and local administration in which the exercise will take place.
Regional, local and area exercise	• It involves regional and local structures of the Civil Protection service on the basis of local event scenarios; • It is planned by Regions, local administration as well as territorial governmental offices.

Table 2. Exercise classification based on territorial scale, type of event and players involved.
Source; Author's elaboration based on the Plan Directive indication

Based on the type of activities conducted	
Command Post exercise (CPX)	• The exercise is conducted among operation centres at the various territorial level; • It simulates the organization of resources and the communication among the different actors involved, test the decisional process as well as the activation time of the coordination system and the intervention procedure; • It does not comprehend any field activity, apart from the presidium of the operational centres.
Field exercise (FX)	• Activation and mobilization of trained teams are simulated; • Conduction of some real activities on the field and activation of operation centres aimed at testing specific aspects of achieving certain objective previously planned.
Full scale exercise (FSX)	• All the different civil protection activities are simulated: prevention, early warning and emergency management; • Operation centres are activated at the different territorial levels as well as the communication network. Real activities are conducted in the field, involving resources and civil society.
Table Top exercise (TTX)	• It is the simulation of a certain scenario in an artificial environment, useful to test decision models regarding Civil Protection plans or develop new procedures; • It usually lasts from some hours to some days; • Participants examine and question about a set of defined tasks.
Discussion-Based exercise (DBX)	• It evaluates and question some specific issues or procedure; • The activity mostly comprehends discussion and confrontation among the participants.

Table 3. Exercise classification based on the type of activity conducted
Source: Author's elaboration based on the Plan Directive indication

5 | EXE Sisma dello Stretto 2022

5.1 EXE Sisma dello Stretto 2022: the execution of the exercise

The first of the selected activities analysed is the exercise *EXE Sisma dello Stretto*, a Full Scale (FSX) and Command Post (CPX) exercise simulating a catastrophic event of national relevance, conducted from the 4th to the 6th of November 2022 in the area of the Strait of Messina.

The exercise scenario is based on a historical seismic event, the earthquake that in 1975 struck the area, with epicenter in the city of Reggio Calabria. It was a particularly destructive event, approximately ninety municipalities between the province of Reggio Calabria and the province of Messina were affected with severe damage. The exercise scenario was defined having those historical data as a reference, but raising the magnitude of the earthquake, to simulate the activation of secondary events like landslides, liquefaction and a tsunami. A complete description of the scenario can be found in the executive document of the exercise, that represents the informational basis upon which the activities of the exercise are planned (Dipartimento della Protezione Civile et al., 2022). Based on this scenario, approximately 37 municipalities in the Reggio Calabria area and 13 municipalities in the Messina area were subject to significant damage, in terms of buildings and infrastructure (Figure 11).

As already mentioned in paragraph 4.6. Civil Protection exercise, Civil Protection exercises have the general purpose of verifying the information contained in Civil Protection plans at the different territorial levels, testing the efficiency of the procedure and intervention models as well as helping to disseminate the contents of the plan to different stakeholders.

In this case, the objective of the exercise was the test of the operative response of the National Civil Protection Service in case of a seismic event of national relevance, therefore Civil Protection Department was the promoter and coordinator of the activity, but the exercise involved all the different territorial and administrative levels included in the Civil Protection mechanism of both Calabria and Sicily. The complete list of the participants is contained in the executive document of the exercise and includes more than sixty entities, among components of the Civil Protection Service (National, Regional and Local Civil Protection organizations), operating structures (firefighters, armed forces, police forces, national health service, competence centres, voluntary groups) and contributing subjects (private and public companies such as telecommunication, utilities and infrastructure

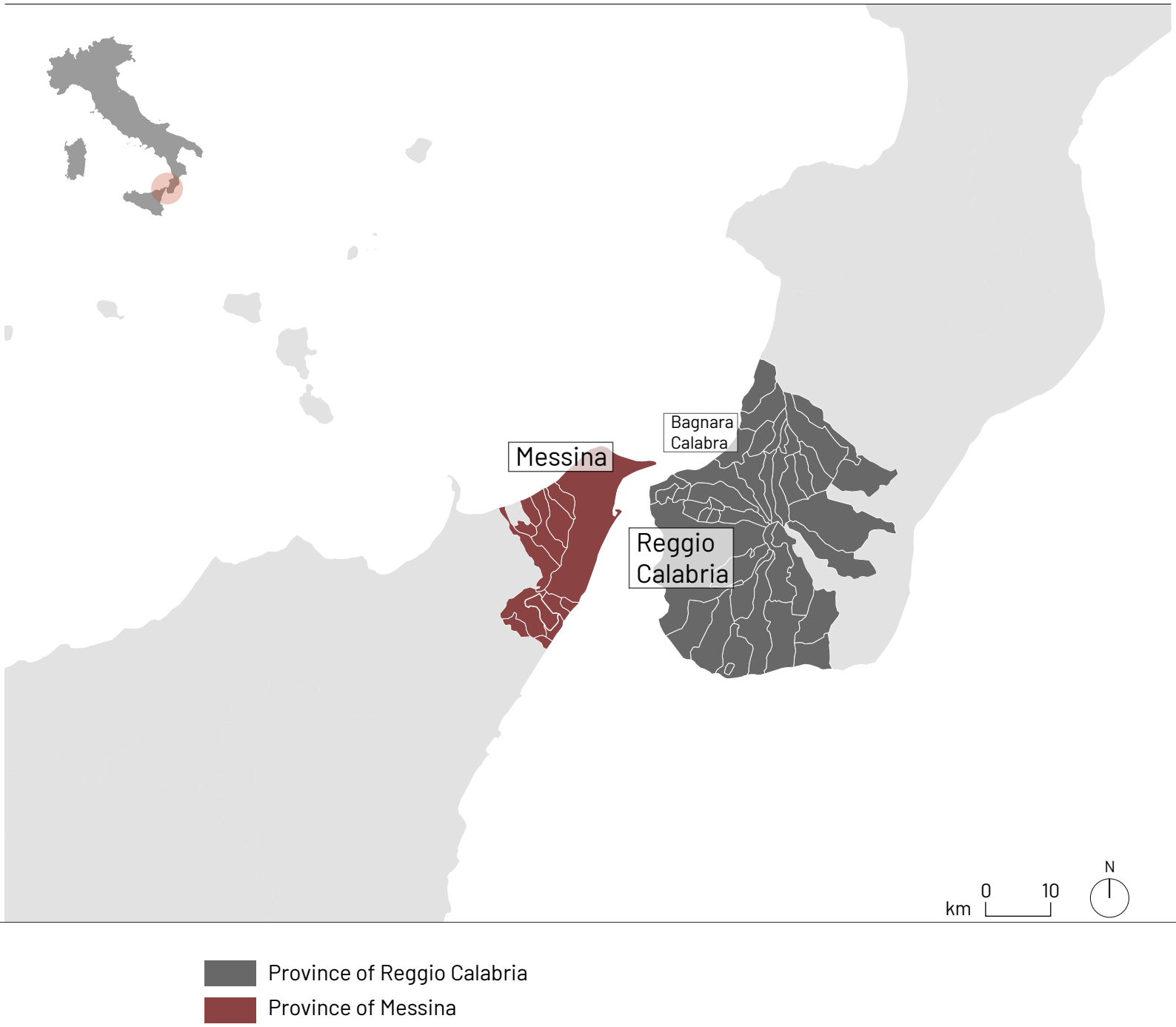

Figure 11. Municipalities included in EXE Sisma dello Stretto 2022.
Source: Author's elaboration based on Civil Protection Department data

companies and engineers, architects and geologists joining the practitioners' civil protection groups).

More specifically, the objectives of the exercise were to verify the progress in the implementation of the Prime Minister Decree of the 14th of January 2014 "National Rescue Programme for seismic risk" (Programma Nazionale di Soccorso per il Rischio Sismico - PNSRS)[1] as well as the local and regional existing Civil Protection plans, in compliance with the national and regional norms and the newly issued Plans Directive.

Together with this general objective, some more specific and sectoral ones were expected:

- To test the national model of intervention through the activation of the coordination centres at the various territorial levels, verifying the emergency communication protocol;
- The implementation of working areas for the emergency technical rescue, the medical assistance and the strategic areas for rescuers and population;
- To test the implementation of a new platform that enables the drafting of the damage assessment sheets *(Scheda AEDES*[2]) for buildings in a fully digital mode (*ERIKUS, ERIKUS mobile and AGITEC System*).
- To test the implementation of a specific configuration called "Catalogo mappe interattive della Protezione Civile" (Civil Protection interactive map catalogue) of the territorial information system of the Civil Protection (SIT DPC), as well as the interoperability of this with other platforms managed by the functional centres.

As it is well described in the Plan Directive, the execution of an exercise involves an ordered sequence of multi-scale and multi-actor activities, which are distributed before, during and after the days of the actual execution. Effective emergency management cannot be a jam session, and in the case of an exercise of such magnitude, the organizational activities started months before the days of the event.

Regarding the pre-exercise operations, they comprehended training session and table of discussion among the different actors involved in the simulation, as well as the preparation of all the technical material needed in support of emergency management operations, hence including the implementation of the spatial infrastructure.

During the days of the exercise, different activities and tasks took place simultaneously in different areas. Immediately following the simulated earthquake,

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1 The PNSRS - Programma Nazionale di Soccorso Rischio Sismico aims to coordinate the intervention of the National Civil Protection Service by providing guidelines for the preparation of emergency plans. It also offers directions for the updating and verification of these plans through periodic exercise.

2 The AeDES form – Agibility and Damage in Seismic Emergencies – is a form for the rapid assessment of damage, the definition of immediate intervention measures, and the evaluation of the post-earthquake usability of buildings with ordinary structural types (masonry, reinforced concrete, steel frame, or shear walls) intended for residential and/or service use.

an IT-Alert warning message was sent to all the mobile phones of the area affected, to test a public warning system for direct information to the population in case of imminent or ongoing major emergencies or disasters [3](Figure 12). At the same time, at the Department of Civil Protection in Rome, the Operational Committee was activated. The Operational Committee is the first entity to take charge of the emergency management in case of national relevance events. It is chaired by the Head of the Department and brings together representatives from national and regional Civil Protection components and structures. Its task is to coordinate emergency management activities until the establishment of DICOMAC – Direzione di Comando e Controllo (Command and Control Coordination Centre), which, in the case of the exercise, occurred approximately two hours after the simulated event, but in real events, may require several days. The DICOMAC is a strategic structure, which is activated only in case of disastrous event of regional or national relevance, whose scope is to coordinate emergency management activities with a direct connection with the local level. It is organized in Functions, according to the Augustus Method organizations. Its location must be defined by regional Civil Protection plans.

Figure 12. IT-Alert message in occasion of EXE Sisma dello Stretto 2022
Source: Author's image

3 IT-Alert is a new public warning system for direct information to the population in case of imminent or ongoing major emergencies or disasters. The system broadcasts useful messages to mobile phones in a given geographical area, warning the population that might be affected by a certain event, as well as giving information about the best procedure to follow. The system is still being tested. https://www.it-alert.it/it/ (Last access on: 27/12/2023)

Additionally, the Operational Committee is in contact with *SISTEMA - Sala Situazione Italia Monitoraggio del Territorio* (Italy Situation Room for Territory Monitoring) to acquire information from the area affected by the event. Within SISTEMA, there is also a connection with the ERCC - European Response Coordination Centre. Regions administrate their local resources according to the information received by the provincial and local administrations affected by the calamitous event, through their local coordination centres.

This cascading system is the structure for the coordination of emergency management activities in case of national relevance disastrous events and allows to integrate national and local capacity (Figure 13).

As time passes from the – simulated – calamitous event, the territorial coordination structures settle, and the emergency management operations continue.

In the case of the exercise, many different training activities were planned, involving a wide range of fields, from assistance to the population, to cultural heritage inspections, to infrastructure damage assessments. In case of a real event, coordination structures are in charge of emergency management activities until the local administration is able to take control again of the damaged territory (Bignami, 2010; Dolce et al, 2020).

For the purpose of the research, the activity of the exercise was followed from the DICOMAC structure.

Among the many activities that were conducted in the DICOMAC structure, the observation and analysis were focused on those related to the implementation of the Civil Protection Department Territorial Information System (SIT DPC). In the case of this exercise, a specific function was dedicated to the implementation of the SIT DPC, with a group of technicians specifically dedicated to this task. A more in-depth description of this activity will be given in the next paragraph, as it is relevant for the analysis of how information flows, risk knowledge is created and transferred during and after the occurrance of a – simulated, in this case - disastrous event.

The last group of activities included in the exercise process are the ones executed after the simulation days. These comprise short-terms activities, i.e. the internal evaluation of the exercise, highlighting strengths and criticalities, and long-term ones, including the implementation of the lesson learned. As one might easily imagine, the implementation of lessons learned is the most challenging part of the process, and it is also difficult to monitor and evaluate.

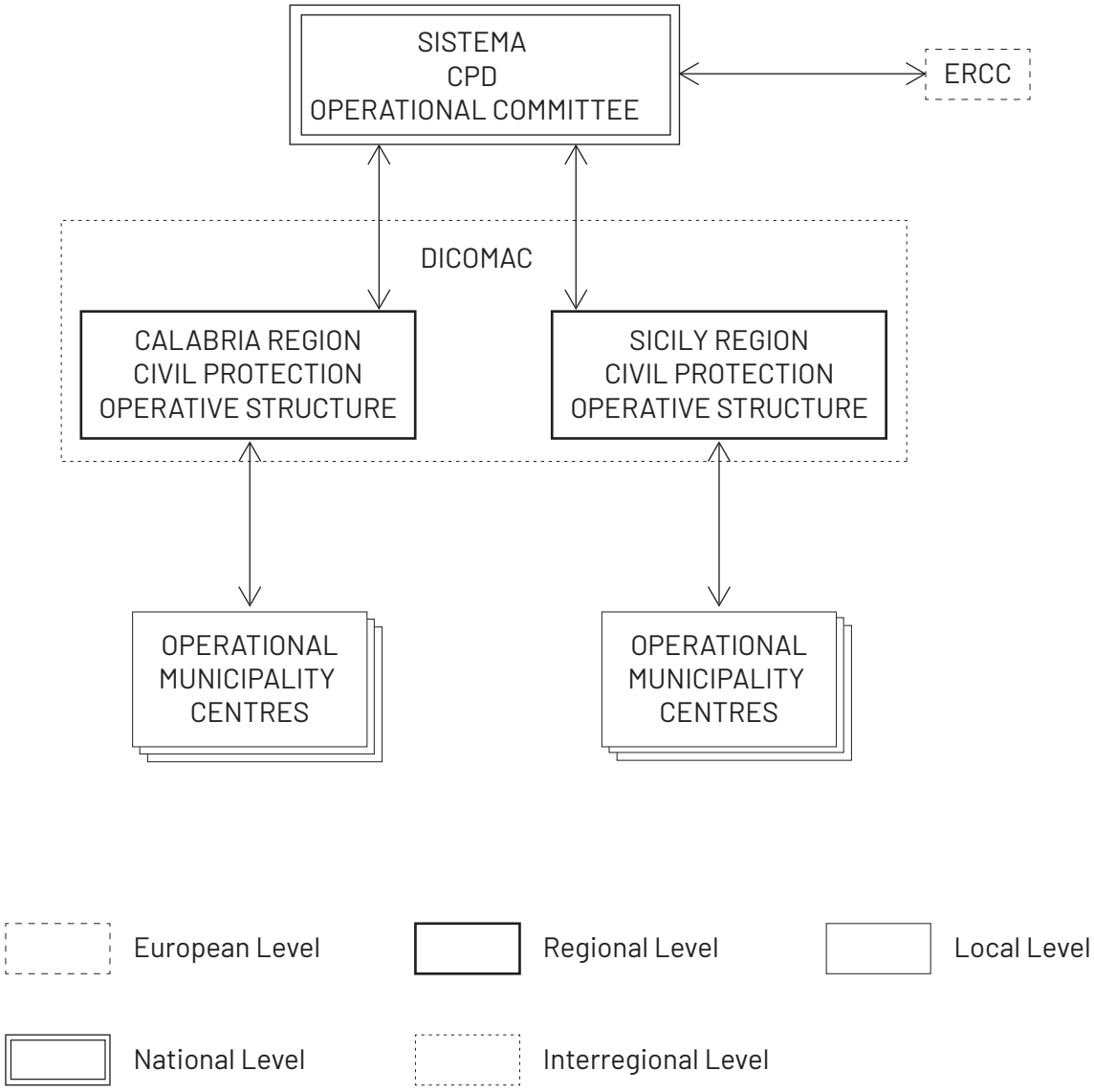

Figure 13. Organization of the emergency management system at the National Level
Source: Executive document of EXE Sisma dello Stretto

5.2 The SIT DPC: Civil Protection Department Spatial Information System

Among the activities carried out during the exercise, the implementation of the Spatial Information System of the Civil Protection Department is the one that is most relevant in relation to the analysis of risk knowledge creation, management and transfer as well as the topic of digital transition and technological tools applied to risk management.

The information described below were collected thanks to the observation conducted during the days of the exercise in the DICOMAC, as well as through the interviews held with long term Civil Protection officers, who during the years have internally witnessed the evolution of the use of spatial information system within the Civil Protection Department and were of great importance for the reconstruction of the process.

There are no official documents explaining this evolution, nor was the innovation formalized in procedures or norms. As already mentioned in *Chapter 4,* the first attempt to formalize the collection of digital information was made with the *Directive of the Presidency of the Council of Ministry of the 14th of February 2014, the "National Seismic Risk Rescue Programme"*, but it is only with the *Civil Protection Code* of 2018, the subsequent Plan Directive and the newly issued "*National Civil Protection Plans Catalogue*" that the standardization of data occurred.

The evolution of the use of spatial information within the Civil Protection Department

The first traces of the use of SDI systems for territorial information management in case of emergencies date back to the hydrogeological events in Sarno in 1998. These were extremely rudimentary systems, implemented locally, which brought together a disorganized set of data, often collected with the assistance of competence centres.

From the early 2000s onwards, following the INSPIRE regulations, the Department began to implement the use of spatial data in a more structured manner, especially from an application perspective. The first internal GIS systems within the Department were implemented for national Civil Protection plans, such as those related to volcanoes. Starting from 2009, more or less complex versions of Geographical Information Systems have been developed by the Department, both for exercises and for real emergencies. However, there is no standardized system in place, nor there are standardized instructions for data collection and sharing.

One of the first emergencies in which there was a more structured use of the Spatial Data Infrastructure is L'Aquila earthquake in 2009. In that occasion the Department implemented a first version of web application, interoperable with other local geographical information systems, like the one of the cadastre, which was as well enriched with data coming from lidar and photogrammetric surveys. The SDI was used mostly for two reasons: for the Technical Function and for communication purpose, mainly for the elaboration of cartography and visuals to share with media

and the wider public.

After 2009, two events boosted the evolution of the Civil Protection SDI use; first one is the Emilia Romagna earthquake in 2012, where the Department worked jointly with the Regional Civil Protection, which was technically advanced in the field, and managed to create an interoperable system including pre-event data and real time surveys as well. Secon one, it was the central Italy earthquake of 2016. In this case, a first web-based platform, widely shared among Civil Protection officers working on the emergency was implemented. This System was mainly intended for visualization purposes, with a set of pre-defined cartography already prepared and the possibility for the general user to build its own maps, according to the data uploaded in the system.

The reconstruction of this evolution of the use of SDI highlights some critical issues.

It demonstrates how, even in this field, emergencies and disastrous events boost the experimentation of effective innovations, yet these innovations are not firmly established in peacetime, indicating a lack of rooted culture of structural use of the digital within the Department. For example, one of the Civil Protection officials that were in charge of the implementation of the SIT DPC during the EXE Sisma dello Stretto highlighted that:

"C'è un grande sforza da parte del dipartimento nel momento di gestione dell'emergenza, con competenze riconosciute anche a livello internazionale, che però non si riscontra nelle fasi di preparazione dell'emergenza. Noi non siamo capaci a programmare, ci comportiamo molto bene in emergenza, anche nei casi di mancanza di procedure specifiche, ma poi ci perdiamo nell'ordinario".

(The Department is really prepared when managing emergencies, and their skills are recognized internationally. But when it comes to preparing for those emergencies, it's a different story. We're great at dealing with crises, even without specific procedures in place. Yet, we tend to stumble when it comes to everyday planning and preparation.)[1]

During the interviews, the recurring need for the digitization of territorial knowledge tools to be integrated into the daily routines of Civil Protection officials was highlighted. This integration is essential for the digital instruments to become automatic responses in the event of an emergency.

An interesting point, which may initially seem contradictory to the findings from the interviews, is the apparent lack of necessity to formalize the use of these tools through specific regulations or mandatory procedures. This approach appears to stem directly from the fundamental principles of Civil Protection. Similar to the approach of the Augustus Method, interviewees believed there is no need for strict norms that regulate the use of these instruments, but rather they should be gradually implemented as a flexible methodology, able to be adapted to the naturally

1 From a semi-structured interview, conducted on the 03.02.2023 with one of the Civil Protection officers working in the SIT DPC functions.

unpredictable character of emergencies. The complexity inherent in emergency situations cannot, in fact, be encapsulated within a protocol of predefined actions; therefore, the establishment of fixed procedures would prove ineffective.

However, this kind of approach relies massively on human capital, as the transmission of best practices and effective methodologies for information management is mostly delegated to informal knowledge transmission among practitioner. This is something that was particularly clear during one of the interviews with the officers working on the SIT DPC.

Many times, the interviewer highlighted the fact that he was the "*memoria storica*" (historical memory) of the Department (since he had been working there for many years, most of them working on the implementation of the spatial information system) and therefore he was the one who was able to provide the more comprehensive information on the topic.

This issue is central in the analysis of risk knowledge information, creation and transfer, as it highlights the need to define methodologies for the valorisation of the informal knowledge transmission among practitioners.

The implementation of the SIT DPC in EXE Sisma dello Stretto

Focusing back the attention on the SIT DPC in the *EXE Sisma dello Stretto*, two were the important tests related to the use of geospatial information for emergency management purpose that belonged to the objectives of the exercise activities: the configuration of the "*Catalogo mappe interattive della Protezione Civile*" (Civil Protection Interactive map catalogue) and the testing of the implementation of the ERIKUS and AGITEC Systems.

As for the first, the "*Catalogo Mappe Interattive della Protezione Civile*" is a specific configuration of the SIT DPC, created in 2020 as an online platform, with restricted access (only Civil Protection officers and people in charge of emergency management can enter the platform), where different projects are implemented, starting from the data stored in the spatial infrastructure. It is a sort of storefront where all the different applications created for the different emergencies faced by the Department are included. This kind of organization can be a useful solution to access previous projects, as they all remain stored in the memory of the catalogue. Moreover, it is user-friendly and easily accessible, even for people who are not familiar with the GIS interface or may not be used to working with geodata. At the moment of the interviews, few projects were implemented in the Interactive Map Catalogue, since the application was relatively new and had not yet been tested on many operational scenarios.

Hence, for the EXE Sisma dello Stretto exercise a specific project on the Interactive Map Catalogue was created. This project acted as the visualizer of the data stored in the SIT DPC. It is through the SIT DPC that the interoperability with other system happens.

The infrastructure implemented for the exercise was composed by data of different nature, selected by the Civil Protection organizers as necessary according

Figure 14. Competence centre and Function working together in the DICOMAC during the EXE Sisma dello Stretto
Source: Civil Protection Department

Figure 15. The Use of the SIT DPC during the EXE Sisma dello Stretto
Source: Civil Protection Department

to the specific aim of the exercise. More specifically, the vertical integration of information concerned the elaboration of different datasets and models, focused on three main topics:

- The definition of the event scenario, which contained:
    - Connection with the INGV earthquake observatory system, showing real-time epicentre of earthquakes in the Italian territory and their intensity. The interoperability between the SIT DPC and the INGV System is rather easy, as they are both built on shared standards;
    - Connection with *RAN – Rete Accelerometrica Nazionale* (National Accelerometric Network), the monitoring network of the seismic response of the Italian territory, based on ground acceleration. This network is managed by the Civil Protection Department; therefore, it is easily integrated into the SIT DPC;
    - The connection with the *OSS – Osservatorio Sismico delle Strutture* (Seismic Observatory of Structures) through which the Department monitors the oscillations caused by earthquakes in 173 public structures, including public buildings, bridges and dams;
    - Connection with the *SIAM – Sistema Nazionale di Allerta Maremoti* (National tsunami warning system) database and the Tsunami Map Viewer developed by ISPRA[2], with the indication of the possible flooding areas (Figure 16);
    - Damage scenario and infrastructure operativity models, developed by EUCENTRE[3] and CNR IGAG[4], two Civil Protection Competence Centre.

- The location of strategic and operational structures, based on the data coming from National Plans (National Seismic Risk Rescue Programme) and – if available – regional and provincial civil protection plans. There is no information regarding local civil protection plans (municipal and inter-municipal level) (Figure 17).

- The mapping of Inspections and surveys, which is the part that was implemented in real time during the exercise and was the second objective

2 ISPRA - Istituto Superiore per la Protezione e la Ricerca Ambientale (Italian Institute for Environmental Protection and Research) is a research institute which operated under the vigilance and policy guidance of the Italian Ministry for the Environment and the Protection of Land and Sea. It is a Civil Protection competence centre, working jointly with the Department in many projects, mainly referring to hydrogeological and land conservation topics.

3 EUCENTRE is a private non-profit foundation and research centre in the field of earthquake engineering and, more generally, of risk engineering. It is a competence centre of the Civil Protection Department, which is also one of the founders of the centre.

4 The Institute of Environmental Geology and Geoengineering of the National Research Council act in the field of the study and understanding of geological and natural processes and anthropogenic activities that interact with the environment, activities and human life. It is a Civil Protection competence centre.

related to the SIT DPC: the compilation in fully digital mode of the AEDES Sheets on building usability and the implementation in the ERIKUS system[5].

Two main criticalities arose.

The first one was already introduced in the previous paragraph and concerns the actual utilization of this instrument. For certain roles, the use of GIS is now an integral part of their daily work, and therefore, they encountered no difficulties utilizing these systems during emergencies. This is exemplified by the Technical Function[6], which includes competence centers such as and INGV, where GIS tools are essential for their operations, indeed some of their systems were incorporated into the Civil Protection Information System for the exercise. However, this was not the case for the totality of the Functions present in the DICOMAC, indicating that the SIT DPC is not yet ready to become a structural cross-sector instrument for emergency management.

Nevertheless, this is not only due to the inadequacy of the spatial information system. It must be highlighted that the timing of the exercise is really strict, and that in "normal" emergency schedules, there would have been more time for the implementation in the system of spatially relevant information which were not included in this case. According to one of the interviewees:

"(Secondo me) l'utilizzo di uno strumento del genere deve venir fuori dalla conoscenza in ordinario e dall'utilizzo in ordinario. Se uno lo conosce e lo utilizza in ordinario allora sta tranquillo che lo utilizza pure in emergenza. Un'altra questione riguarda il fatto che uno strumento di questo tipo lo utilizzi nell'attività della DICOMAC, che dura settimane/mesi in caso di emergenza vera, al contrario delle tempistiche che abbiamo invece in caso di esercitazione"

("I think using a tool like this needs to come from everyday familiarity and practice. If someone knows and uses it regularly, they'll be comfortable using it during an emergency too. Another thing is that in a real emergency, you'd use this tool for weeks or even months, especially in the DICOMAC operations. This is different from the short time frames we deal with during drills.")[7]

The second criticality regards the topic of data interoperability and sharing protocols, which is one of the main obstacles to the effective use and implementation of digital instruments. In some cases, the integration of different systems into the SIT DPC was straightforward due to shared standards already existing and implemented.

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5 The ERIKUS System is an application developed by the Regional Civil Protection Piedmont, based on QGIS, which enables the management and cartographic representation of surveys regarding the post-earthquake usability of buildings.

6 The Technical Function is the one that maintains and coordinates all relationships between various scientific and technical components for the physical interpretation of the phenomenon and data related to the event. See Paragraph 5.2 for a more detailed description.

7 From a semi-structured interview, conducted on the 15.12.2022 with one of the Civil Protection officers working in the SIT DPC functions.

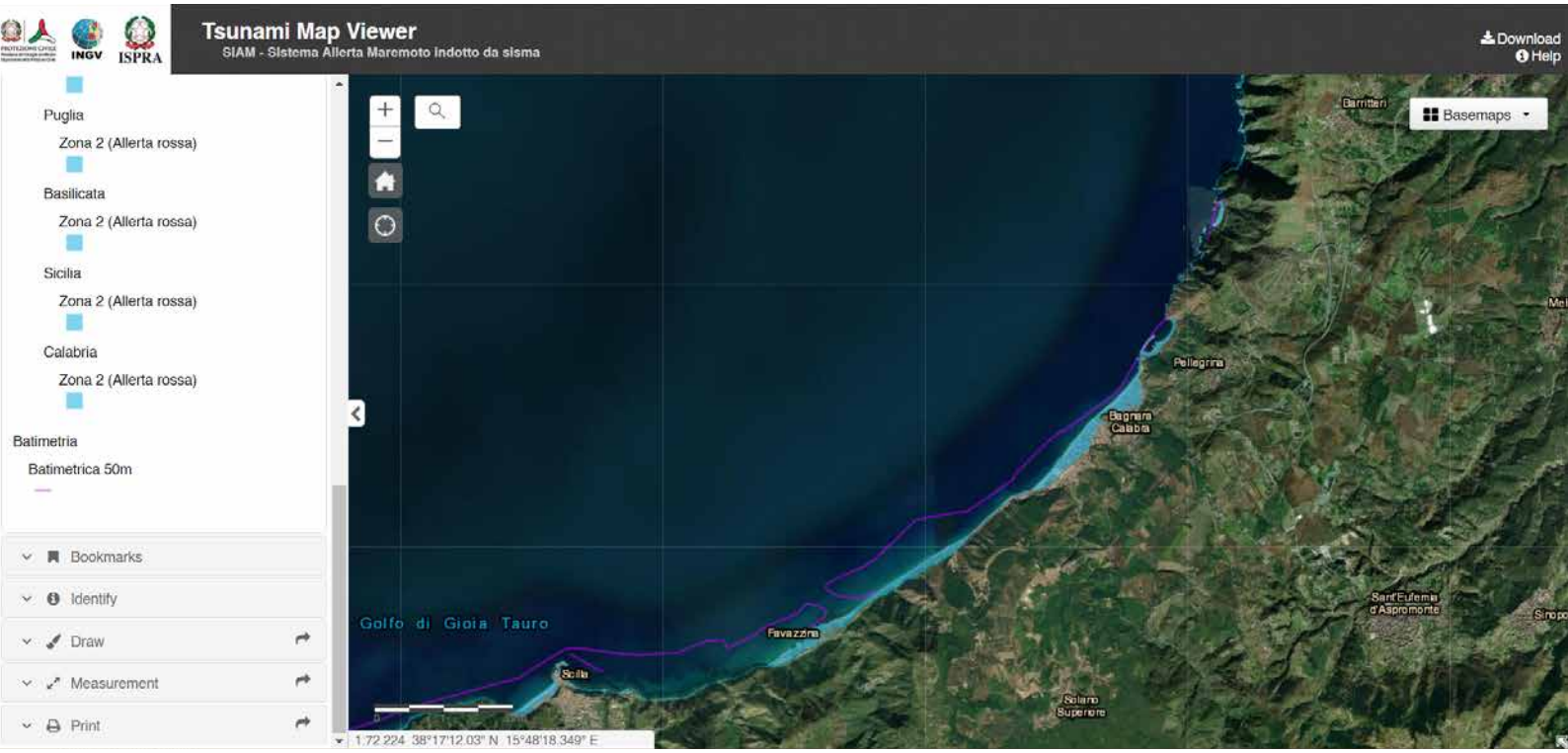

Figure 16. SIAM Tsunami Map Viewer. Focus on the area of Bagnara Calabra
Source: Tsunami Map Viewer https://sgi2.isprambiente.it/tsunamimap/

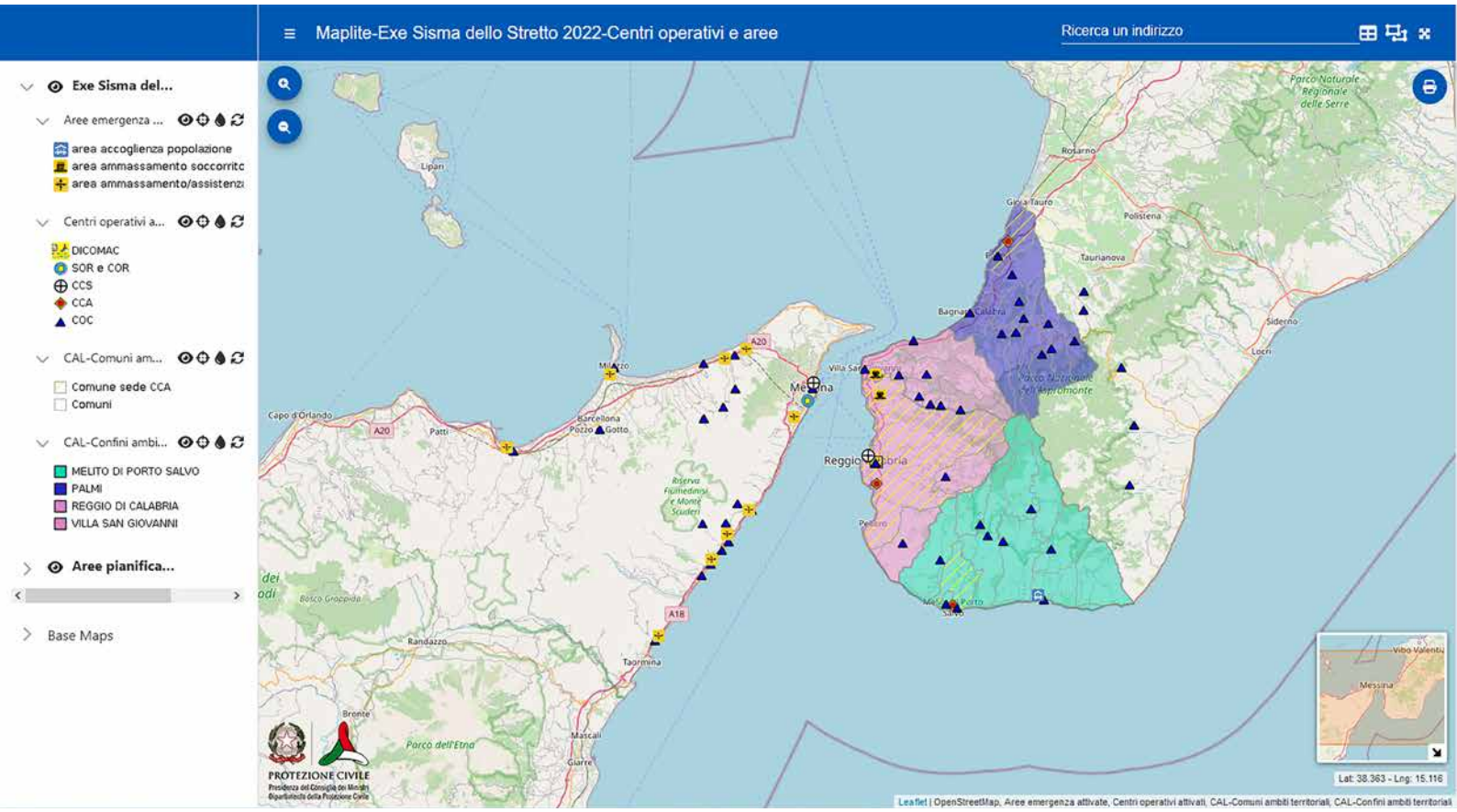

Figure 17. The Configuration of the Map Catalogue, showing the location of the strategic structure described in the Civil Protection plans of the area
Source: Civil Protection Department

Figure 18. An example of the interoperability between the SIT DPC and the INGV system during the EXE Sisma dello Stretto
Source: Civil Protection Department

For example, SIT such as those from INGV or the RAN and OSS systems, which are managed internally by the Civil Protection Department, were already constructed using common standards. This pre-existing compatibility facilitated their seamless integration into the SIT DPC.

Conversely, other situations presented significant complications. One of the main issues was the inconsistency in data visualization. This included discrepancies in legend standardization, colour schemes, symbols, units of measurement, and data representation methods (e.g., qualitative scales such as low-medium-high versus specific quantitative values). An example is the damage scenarios and infrastructure operativity model developed by EUCENTRE and CNR IGAG. Those two competence centers used different methodologies for representing the operativity of infrastructures. EUCENTRE provided estimates of the functionality percentages for key infrastructures like ports and main roads, while CNR IGAG provided the optimal infrastructure network. These differing representation methods led to confusion in interpreting and utilizing the information, which in case of emergency can represent an obstacle to the smooth organization of the rescue operation.

There is also a notable problem with overlapping and coherent information. Data transmitted from the competence centers to the SIT DPC are validated individually by each center responsible for their processing. However, there is no cross-validation among different models. Consequently, as it is now implemented, the SIT DPC becomes a system of layered information that does not interact with each other, failing to generate new, integrated knowledge.

Another critical issue is the integration of Civil Protection planning data at various territorial levels within the SIT DPC. The level at which this data is referenced plays a crucial role in its integration. For the exercise, the system successfully incorporated data from the National Seismic Risk Rescue Programme, including the locations of strategic and operational structures. These datasets were already part of a national-level plan overseen by the Civil Protection Department and were organized according to standards compatible with the SIT DPC. Additionally, the system included data from the optimal context, which are managed by the Regional Civil Protection.

Nevertheless, data related to municipal-level planning were notably absent.

In the case of the *EXE Sisma dello Stretto*, this absence was a strategic decision, as the integration of municipal data was not considered in the objectives of the exercise. Beyond this strategic consideration, there was a significant practical challenge: the Department did not possess these municipal planning data, because it still does not have a national platform that integrates Civil Protection planning data from different territorial levels and regions.

The integration of shared platform of this kind of information is a task demanded to Regional Civil Protection services, which therefore implemented it with different standards, levels of detail and coverage, depending on each specific regional situation.

However, the Plan Directive tried to solve the issue, introducing the concept of the digital plan, to be implemented through the “National Civil Protection Plans

Catalogue," a nationally integrated spatial information system. At the time of the exercise, the operational guidelines for these standards were not yet available and were only published in January 2024[8].

Moreover, the Civil Protection of Calabria Region reported not having digitalized information on the plans, although there was disagreement among some Civil Protection Department officials on this point. It appears that changes in the regional administration led to data loss, highlighting the previously mentioned issue of how information transmission often occurs informally and relies heavily on human capital.

5.3 Assessing the Effectiveness of the SIT DPC in Disaster Risk Knowledge Creation and Transfer

EXE Sisma dello Stretto was an interesting occasion for the investigation of how the process of knowledge creation happens during a catastrophic event. Understanding disaster risk and raising risk knowledge, in fact, is fundamental for increasing the capacity of institutions, community and decision makers to cope with risk, as well as to take risk-informed decisions (UNDRR, 2015).

During disastrous events, great amount of new data is produced, not only related to the possible changes in the hazard scenario, but also to the modifications of the affected elements and to the action conducted to deal with the event. For this data to become information and then, risk knowledge, they need to be integrated into the wider system to which they belong: the data must be correlated with the overall context and the reference scenario of the event and must be understood and interpreted by those involved in emergency management (Spiekermann et al., 2015; Weichselgartner & Pigeon, 2015). *Paragraph 3.3.1. The Role of Technology* explained how SDIs can help– to some extent – in this process. Furthermore, they can assist in overcoming the risk knowledge transfer gaps identified by Albris (2020a), especially regarding the strategic reasons, which deal with the lack of common visions and goals. At the core of an SDI lies the need to define a common objective and the users' requirements (Masser, 2005; Butler 2015; Laurini 2017). Moreover, the effort required to translate data so that they become comparable, standardized, and interoperable within the infrastructure, enabling them to be contextualized to create information, can help bridge communication barriers between disciplines.

To understand whether the SIT DPC has effectively served as a tool for risk knowledge creation and for overcoming the risk transfer gap, it is necessary to analyze it through this lens.

8 Directive of the Presidency of the Council of Ministry of the 29th of January 2024 "Operational indications concerning the informative organization of territorial data necessary for the implementation of a nationally integrated computer platform called "National Catalogue of Civil Protection Plans". The purpose of the provisions is to encourage a process of "digitization" of civil protection plans with a view to homogenization of data, as well as interoperability between information systems at all territorial levels while respecting local autonomy, responding to the need to make the contents of civil protection plans uniform and interoperable at different territorial levels

There are some positive elements that helped the contextualization of data useful for knowledge creation. First, the SIT DPC is not conceived as a standalone platform, but rather as a composite system, interoperable with other spatial infrastructure, like the monitoring systems managed by INGV or the ERIKUS database populated by on-site surveys of building usability. The system enables automatic updates during emergency management, continuously providing information on the development of event scenarios and damage. Additionally, it populates a potential database capable of documenting the evolution of the emergency over time. The testing of the compilation in fully digital mode of the AEDES sheets on building usability and the consequent implementation in the ERIKUS system was a perfect example of systems interoperability and effective use of digital tools. Digitally completing the AEDES sheets significantly shortens processing times, reduces the likelihood of errors, and ensures data collection complies with established standards. Additionally, this approach allows for real-time updates of the situation on the ground, thereby facilitating the efforts of rescue operations.

Another positive element is the attempt to include in the spatial infrastructure data of different nature, not only in relation to data type (raster, vector, tables…) but also concerning the content. Different sources of hazard conditions were considered, and the construction of risk scenario sought to examine the effects on multiple systems (for example historical centers and infrastructure).

However, this integration is not conceived as a holistic synthesis of knowledge framework, but rather as a sterile overlay of layers, sometimes containing redundant information. This issue is exemplified in cases such as the infrastructural operativity developed by CNR IGAG and EUCENTRE mentioned before. Moreover, the absence of cross-validation exacerbates the problem, leading to duplicated information and an unclear definition of the output needed.

This approach results in both the cause and effect of the underutilization of the digital infrastructure.

Due to the limited use of the platform, users fail to fully understand its strategic potential. Consequently, the platform's strengths are not clearly articulated, and the mechanisms for acquisition, processing, and extraction of outputs are intricate and not user-friendly. This complexity deters users, especially in emergency situations where time constraints represent an obstacle to experimenting with unfamiliar tools.

As for risk knowledge transfer analysis, in the specific case of the *EXE Sisma dello Stretto,* the SIT DPC acts as connector in two defined moments: the preparation of the exercise, when all the scenario information is implemented to set the instrument for the days of the exercise, and the transmission of data concerning building usability to the to the response and recovery phase. It has the potential to connect the prevision phase, with the emergency management, and finally with the response and recovery phase. However, this theoretically smooth connection is hindered by all the criticalities explained above, resulting in a underusage of the potential of the instruments.

Moreover, as risk knowledge transitions from one phase to another in the

disaster cycle, the issue of competence becomes crucial. This competence is understood as both the "ownership" of information and the responsibility to convert that information into knowledge and into action. It would be incomplete to view technological tools as the sole means of transmitting risk-related knowledge, especially considering that interviews have highlighted the significant role played by human capital and informal transmission of knowledge, even in structured contexts such as those within the Department of Civil Protection.

The analysis of the *EXE Sisma dello Stretto* has highlighted potentials and criticalities in the use of digital tools and spatial infrastructure as instruments of knowledge creation and transmission aimed at increasing capacity (Figure 19). The analysis reveals that while the SIT DPC has the potential to become an effective support tool, it currently continues to exhibit the same critical issues identified in the literature. Those criticalities will be the starting point for the discussion and propositions presented in the third and last part of this dissertation.

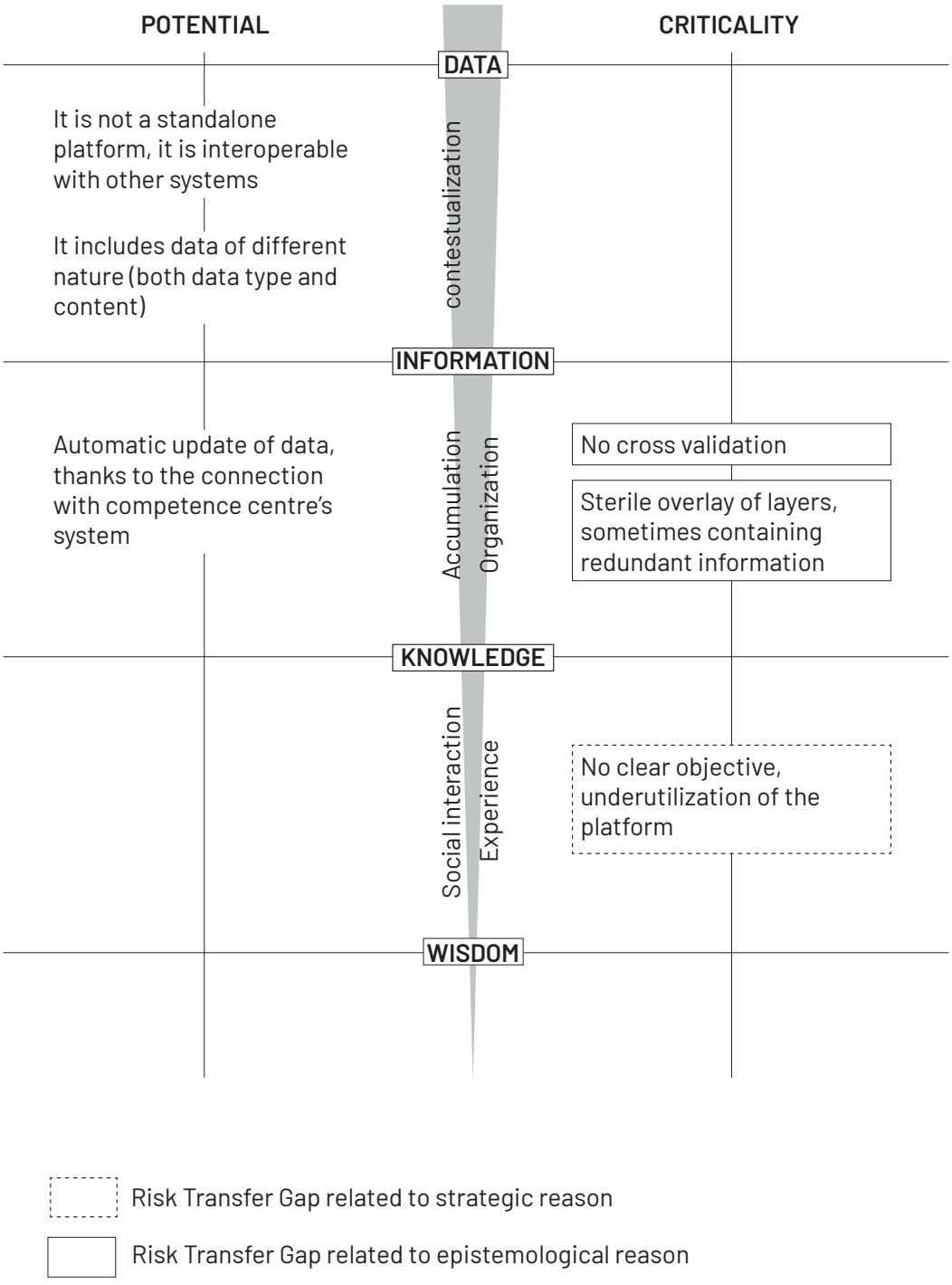

Figure 19. Potentials and criticalities in the use of the SIT DPC as instruments of knowledge creation and transmission
Source: Author's elaboration

6. Civil Protection participatory planning in Bagnara Calabra

6.1 The town of Bagnara Calabra: territorial framework and risk conditions

The municipality of Bagnara Calabra is situated in the Tyrrhenian area of the metropolitan city of Reggio Calabria, covering an area of approximately 25 square kilometers, with a population of around 10,000 inhabitants. The majority of the population lives in the main urban centre, which lies in the natural amphitheatre formed by the coastline and the surrounding mountainous area. This is divided into two areas: the historical center, located on the Marturano Cliff, and the new town. The historical centre urbanisation gradually descends towards the sea and becomes the new town, which is divided in two distinct zones by the same Maturano Cliff. The southernmost zone was completely reconstructed following the earthquake of 1738 and is laid out in a regular grid pattern, while the area immediately north of the Marturano Cliff corresponds to the Marinella district, known as the "fishermen's district," and is of more recent construction. The municipality also comprises two additional hamlets, separated from the main urban nucleus: Pellegrina and Solano Inferiore, located in the mountainous area at the border with the surrounding municipalities (Figures 20 and 21).

According to the risk conditions described in the different planning documents of Bagnara Calabra[1], the municipality is particularly fragile. The overview of hydrogeological hazards reveals a significant percentage of landslides, which to varying degrees threaten residential buildings, commercial and industrial structures, and critical infrastructure. A similar situation applies to hydraulic hazards (Figure 22). Furthermore, like much of the Calabria region, the municipality of Bagnara Calabra falls within a high seismicity zone and has been classified as Seismic Zone 1, the most hazardous category where strong earthquakes are expected[2]. Historical data regarding earthquakes in the area confirm the classification (Rovida et al, 2022).

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1 The information on the risk scenario of Bagnara Calabra where mostly taken from the definition of the risk scenario developed for the Civil Protection Emergency plan adopted (and in course of revision with the participatory project) and from the documentation of the intermunicipal master plan documentation that was drafted in 2014, never adopted, which contains a detailed description of the territorial, historical and morphological context of Bagnara Calabra (*Piano Strutturale Associato, Quadro Conoscitivo, 2014).*

2 From *Deliberazione della Giunta Regionale 10 febbraio 2004, n. 47 "Prime disposizioni per l'attuazione dell'Ordinanza del Consiglio dei Ministri n° 3274 del 20/03/2003 "Primi elementi in materia di criteri generali per la classificazione sismica del territorio nazionale e di normative tecniche per le costruzioni in zona sismica"*

Moreover, the coastal zone of the municipality is classified as High and Very High-Risk concerning storm surges according to the "Flood Risk Management Plan," due to the proximity between the urban center and the coastal area. Additionally, due to the high seismicity of the area, it may be affected by tsunami events. An analysis of areas potentially exposed to tsunami waves in Bagnara Calabra, which can be inferred from the tsunami alert zone maps developed by ISPRA (Tsunami Map Viewer platform) (Figure 16), reveals that the entire coastal area is highly at risk. In case of significant tsunami events, a considerable portion of the urbanized area of the new town would be affected, particularly the Marinella district.

The overall picture of the municipality's risk conditions presents a rather complex situation, necessitating urgent and effective risk reduction interventions.

It is in this framework that the participatory process of the drafting of the Civil Protection plan of Bagnara Calabra took place.

6.2 The participatory planning process

As already mentioned in the introduction of Part II: Case Study Analysis: Italian Civil Protection system, the participatory planning project started in occasion of the EXE Sisma dello Stretto exercise, as Bagnara Calabra was selected by the Civil Protection Department as a possible interesting use-case for the testing of participatory planning methodologies, also in the light of the - almost – newborn Plan Directive.

The aim was to test the participatory process for the drafting and updating of the Civil Protection plans, hoping to make the Bagnara Calabra test a good practice for other municipalities in the same condition. The municipality agreed on the involvement in the project, mobilising some of the figures of the town council and rapidly adopting a new Civil Protection Plan[1] (in substitution of the old one, that was from 2010), formerly commissioned to an external practitioner's firm. Different are the stakeholders involved in the process, representing the many different territorial levels and the many different levels of governance that compose the process of risk governance. A sharper focus on the stakeholders will be given in the next paragraph, but for this stage of the analysis it is necessary to highlight the role of *Fondazione CIMA*, the competence centre of Civil Protection Department which is in charge – among other roles - of the technical and specialistic support for the participatory processes.

Fondazione CIMA is an international centre for environmental monitoring and non-profit research centre, working in the field of Civil Protection and risk mitigation. In 2012 became competence centre for the Civil Protection Department and in 2020, with the Civil Protection Code, was confirmed as operational structure of the National Service of Civil Protection.

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1 The current Civil Protection Plan was adopted on the 23rd of September 2022 and represented one of the first action of the newly installed town council. The implication of this choice will be discussed in the following lines.

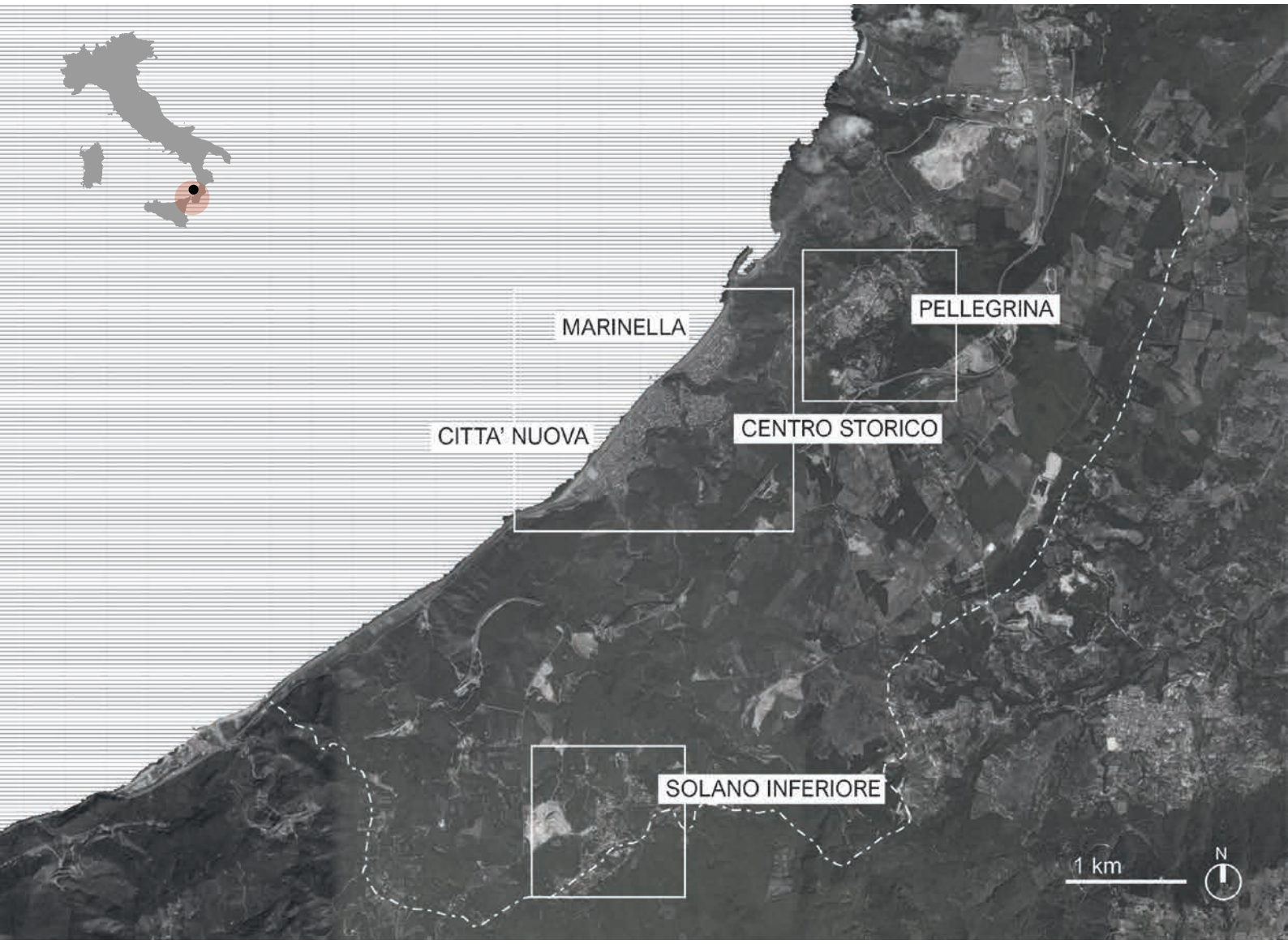

Figure 20. Overview of Bagnara Calabra administrative territory, with indication of the different districts
Source: Author's elaboration on Google Maps orthophoto

Figure 21. View of the town
Source: Author's photo

The district in the foreground of the picture is Marinella, while it is visible, on the top of the Marturano Cliff, the historical center. The southern zone - the one that has been rebuilt after the 1738 earthquake - is not visible, being behind the Marturano Cliff. In the back of the picture, there is the massive Sfalassà Bridge, the third highest bridge in Europe. This picture well explain the relation of the town with the surrounding territory, as well as the possible difficulties that might derive from it.

Figure 22. View of one of the flow channels that discharge water from the mountainous area
Source: Author's photo

This is a typical example of the situation of the buildings in the town; the riverbed is cluttered with materials and buildings are built close to the banks, which together with the hydrogeological hazard of the area, make this elements particularly at risk.

The working methodology underlying the process is developed by *Fondazione CIMA,* which boasts numerous experiences in participation projects. According to their approach, participatory planning is able to trigger the moving process of the Civil Protection plan from the solely preparation phase of the disaster cycle to the prevention and mitigation one, as the participatory process act upon the coping capacity of the community and of the stakeholders engaged in DRR, therefore lowering the level of risk.

The general methodology used from *Fondazione CIMA* is articulated in different phases of work[2]. In accordance with the different situation, the method might be adapted to the specific context.

The first step of the work is represented by the informative phase and the interactive training, useful for building a common language and a shared basis of information and knowledge between all the different actors taking part in the process. It is in this phase of the work that training meetings are usually organized, according to the specific needs and objectives defined for the project. In the case of Bagnara Calabra, several training sessions have been organized, concerning the most relevant topics related to DRR and Civil Protection planning, as well as specific insights related to the needs of the particular context. More precisely, the training meetings concerned: the general organization of the National Civil Protection System, risk affecting the Calabria Region, the regional hydrogeological and tsunami warning system, general insight on Civil Protection planning, Civil Protection voluntary organization, community engagement and the management of vulnerable people in case of emergency.

The second step of the methodology concerns the configuration of the planning process, choosing the objectives to reach and the criticalities to handle. In the case of Bagnara Calabra, in addition to the primary aim defined, some more specific objectives were selected: to focus on the management of vulnerable people (people with disabilities, elderly individuals) and to define an effective strategy for risk communication. The inclusion of external stakeholders, competent for that area of expertise, was fundamental for the outcome of this stage.

Third phase of the process regards the actual execution of the participatory process, which happens through meetings between stakeholders, local authorities, experts and population, workshops, focus groups, exercises and different kind of collective action As for Bagnara Calabra, the activity of the participatory process began in October 2022, with a series of training and informative meetings in preparation for the EXE Sisma dello Stretto and has been going on until now[3]. The main activity conducted was represented by meetings with local authorities,

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2 Information about the methodology have been collected during the many preparatory meeting among the municipality, Civil protection organization and *Fondazione CIMA* that I was able to observe, as well as from the contribution presented in the occasion of the International Conference LIFE FRANCA 21-22 October 2019 – Trento, which presentation is available online: https://www.lifefranca.eu/wp-content/uploads/2019/10/15_Participatory-process-for-Civil-Protection-planning.pdf (Last access: 25/04/2024).

3 The issue of the temporality of this process was central in the analysis conducted during this research, both for methodological reasons (practical and logistical implication of choosing an on – going case study) and theoretical ones.

regional and national Civil Protection agents, technical experts and different types of associations, representing the community (for the complete list of the stakeholders engaged in the process, see Annex II). The community always took part in the meeting through the filter of the associations, no single citizen decided to take part in the meeting on their private intention. The observation of the process lasted almost one year and a half. During this time, various in person meetings were conducted, which added up to the online ones, and the tabletop exercise that was designed by *Fondazione CIMA* specifically for Bagnara Calabra (Table 8, Annex II)[4].

Last phase of the methodology concerns the definition of shared action between the community and the local administration, and the formalization of the results obtained. In the case of Bagnara Calabra, this is a phase that is still ongoing, as the updating of the Civil Protection plan has not yet happened. However, another important objective has been reached, with the definition of a collaboration pact between the municipality and some associations of citizens. A more in-depth analysis of the pact will be conducted in the next paragraphs.

The phases of the methodology described above must not be considered as perfectly sequential nor fixed. For example, it is common that, during the definition of the process, the necessity of specific training relating to certain topics of interest for the project emerge, as well as it might happen that the results obtained with a certain type of activity change the outcome imagined. Not only the object of the project should be participative – the Civil Protection plan, in this case – but also the project itself must be open to contamination.

In conclusion of this first paragraph, few words about the Civil Protection plan adopted by the administration of Bagnara Calabra need to be spent, even though it is not the technical content of the plan the object of this analysis.

The actual Civil Protection plan of Bagnara Calabra was adopted on the 22nd of September 2022, as one of the first initiatives of the new town council, settled in June of the same year. According to the interviews conducted with the local administrators, as they decided to take part in the participatory process proposed by the Civil Protection Department, they fastened the adoption of the plan, to have an instrument to work on, considering it a necessary step for the development of the process. The plan was drafted by an external practitioner's firm, hired by the previous town administration. From the beginning, the local administrators were not satisfied with the content of the Civil Protection Plan; they often argued that the plan was too general, did not consider many specificities of Bagnara Calabra and used old data. From one side, it is positive that local administrators reclaim their local knowledge rights, recognizing that external practitioners were not able to identify and represent properly their territory and their assets. However, on the other side, they seem to consider the plan as an external object, a bureaucratic passage to comply with, of which the administration is not in charge and is not responsible and therefore not acting in first person to change it. This kind of approach is very typical in the case

4 Among the specific objective of the process that were identified with the local administration, there was one related to the enhancement of the capacity of local actors in charge in case of emergency. Therefore, Fondazione CIMA and the municipality decided to execute a tabletop exercise to train on the procedures described in the plan, that was conducted in October 2023

of Civil Protection planning instruments, which still are considered by Municipal Administrations to be mere bureaucratic fulfilment (Bignami and Menduni, 2021a). On the contrary, the technical opinion of *Fondazione CIMA* regarding the plan adopted was not so critical. They agreed with the local administrators in considering the plan rather general but added that it was technically correct.

Supposedly, these premises appear to be suitable for the construction of a participatory project. First, the municipality administration is apparently proactive and - most important - newly installed, enabling to work with a longer time horizon. Local administrators are often hesitant to define long term programs or actions (such as imposing constraints or relocations) as they are subject to electoral pressures (Balducci, 2020; Menoni, 2020), therefore participatory processes can prove to be powerful tools for managing potential conflicts that might emerge during the implementation of controversial DRR interventions. Moreover, they have at their disposal a technically correct planning instrument, which, however, needs to be improved and customized based on the specific needs of the territory under consideration. Finally, they have the technical support of sector experts (Fondazione CIMA and Civil Protection Department). However, these positive premises have been insufficient to ensure a positive outcome of the process. While the population has demonstrated itself to be involved and proactive, the local administration, after a first moment of enthusiasm, lost interest in the project. They continuously tried to avoid technical responsibility for the plan, delaying the drafting process. After almost two years from the beginning of the project, the updated version of the plan still has to be concluded and adopted.

6.3 Retracing Risk governance network

The analysis of the stakeholders included in the participatory process of Bagnara Calabra well represents the comprehensiveness, complexity and multiscalarity highlighted in the risk governance discourse, as they belong to different territorial levels, different institutional compositions and bear different responsibilities.

Starting from the higher territorial level, the national one, the first stakeholder involved in the process is the Civil Protection Department (CPD), which is the promoter of the initiative and acts as the institutional container. The involvement of the Civil Protection Department is mainly formal; during the definition phase of the project, it was the Department that put the municipality of Bagnara Calabra in contact with Fondazione CIMA's scientific experts. Moreover, the CPD provides technical-methodological support through its officials, who, as needed, took part in different activities, such as training ones. It has no direct competence in the drafting of the plan.

One step below the national level, there is the regional one, where the Regional Civil Protection belongs. Even if from a normative point of view, the role of the regional and national level is different, in the practice of the process the presence of both territorial levels showed a superposition of competences. The role of both divisions of Civil Protection have been, in fact, to provide methodological and

Figure 23. One of the first participatory meeting. Here, with the Pellegrina population.
Source: Author's photo

technical support, as the direct responsibility for planning is only in the hands of the local level. Unfortunately, the contribution of the Regional Civil Protection was rather weak, as the Civil Protection Department has partly outweighed its role.

Officers of the Regional level only attended few meetings, not taking part actively in the discussion.

This was surely a criticality of the process, especially because according to the Civil Protection Code and the Plans Directive, the regional level is the one in charge of the definition of guidelines for Civil Protection planning, for monitoring planning conditions and for data collection, updating and implementation of the plan catalogue. Moreover, a more active inclusion of the regional level could have opened the way for starting a discourse about interaction between Civil Protection planning and territorial governance, being both competence of the same territorial level – even though, of course, not of the same authority (Civil Protection on one side and regional administration on the other). Consequently, a further committed engagement of the regional level could have been a great opportunity for widening the activity of the participatory process to a more comprehensive scope.

Last link of the institutional chain is the municipal level. This is the level where there should be the most commitment, as the institutional actors and the technicians of the municipal level are the ones formally in charge of Civil Protection planning. As for the Bagnara Calabra case, the mayor and the two municipal councillors with responsibility for Civil Protection followed the whole process personally, attending all the meetings and coordinating locally the activity and the communication with other local actors involved. The presence of the mayor and town councillors is of central relevance, as they are the one directly in charge for Civil Protection responsibility. Occasionally, other members of the town council attended the meetings, especially if their focus was related to specific activities for which they were responsible[1]. However, as already mentioned, the continuous presence of the municipal administrators has been mainly formal. The participatory process was unable to mobilize the municipal administration either on the works directly associated with the plan or on any other potential structural or non-structural interventions aimed at reducing risks in the area. Context conditions, related to political problems coupled with a particularly difficult situation with regard to the socio-economic conditions of the town, have influenced these results.

Relevant, non-institutional stakeholders involved at the local level are community associations and religious associations. Along the process, many were the population groups that joined the activities (See stakeholders' list in Annex II). In the very beginning, religious associations played a central role, as they have a grounded presence in Bagnara Calabra community and therefore acted as connectors between the institutional demands and the population. For the construction of the relationship of trust between the population and institutional actors (be they the municipal administration or external technicians), conveying information through

1 An explicative example is represented by the meeting for the preparation of the evacuation activities in the schools during the day of the EXE Sisma dello Stretto exercise (4th of November 2022). In that occasion, it was always present the councillor with responsibility for welfare and education, who, however, once the exercise ended, stopped attending the meetings.

the intermediary step of associations or figures rooted in the territory appears extremely useful. Indeed, they can act as intermediaries between institutional information and the community, fostering connections (Satizábal et al., 2022).

While in the first period of the process religious associations were relevant players, in the second period they slowly disappeared, leaving space for community associations related to the assistance of vulnerable people, especially people with disabilities. The presence of these associations, together with the presence of *Abili a Proteggere*, shaped the objective of the participatory process, including the focus of disability in the plan and in the project.

Abili a Proteggere, Labsus – Laboratory for subsidiarity and *Fondazione CIMA* are cross-level stakeholders, as they do not belong to a specific territorial definition and act as external technical consultants.

Fondazione CIMA, which has already been introduced in the previous paragraph, is a research centre and competence centre of the Civil Protection Department, specialized in environmental monitoring, risk mitigation and Civil Protection participatory planning. They are the ones that organized the whole process, defining the method, setting the meetings, and orienting the development of the work, acting as mediator between institutional actors (CPD – RCP – Municipality) and the population.

Abili a Proteggere is an internal project of the Civil Protection Department, devoted to the study, research and design activity on the topic of disability in Civil Protection practices. They followed the project giving specific advice related to the topic within their competence.

Lastly, *Labsus – Laboratory for subsidiarity* is an association focused on horizontal subsidiarity and active citizenship. *Labsus* is specialized in building participatory processes between institutions and citizens on issues of shared administration, focusing on the care, management, and regeneration of common goods. In the Bagnara Calabra case, Labsus acted as mediator in the participatory project, as well as technical advisor for the implementation of the collaboration pact on Civil Protection activity, an innovative outcome of the participatory process that will be further discussed.

Finally, for the sake of completeness, a few other stakeholders that joined discontinuously the process need to be mentioned. First of all, the local Red Cross voluntary organizations and the social services, which, especially with regard to the focus on disability, are to be considered relevant actors for the development of the project. The local Red Cross association attended some meetinsg in the initial part of the process and signed the collaboration pact. Being the Civil Protection voluntary organization absent in Bagnara Calabra (the creation of a voluntary CP group represents one of the objectives of the collaboration pact), the possibility of including an already structured voluntary organization represents a significant opportunity for the development of territorial knowledge and connections.

Then, professionals from *ISPRA – Istituto Superiore per la Protezione e la Ricerca Ambientale* (Italian Institute for Environmental protection and Research)

and I*NGV – Istituto Nazionale di Geofisica e Vulcanologia* (National Institute of Geophysics and Volcanology), both competence centre of the Civil Protection Department, took part at the first meetings and training activity, in representation of the scientific community.

The presence of representatives from the scientific community is relevant for many reasons: first, scientific community and Civil Protection have a long history of collaborations and CP decision makers have always relied on results coming from scientific research (Dolce & Di Bucci, 2022); then, the possibility for the community to identify clear roles and responsibilities – therefore separating administrative roles, from technical ones, from scientific ones – helps in defining everyone's competences and building the relationship of trust in the institution necessary to establish an effective participatory process (Satizábal et al., 2022).

However, the presence of the scientific representatives also provided empirical evidence of the institutional risk transfer gap identified in *Chapter 3*.

In fact, communication between scientists, administrators and community leaders has not taken place effectively. Different are the reasons for this miscommunication. First, although the division of roles between technicians, scientists and administrators was clear, the division of competences of each was not, thus creating confusion in the allocation of responsibilities. Then, there was a lack of specific communication strategies and languages suitable for the audience, that hindered the conditions for truly transversal exchange between population, administrators and scientific community. It was complex to transmit risk-related technical-scientific concepts, for example regarding hazards affecting the territories. These conditions detained the co-production of knowledge, making the integration of formal and informal, scientific and local knowledge impossible (Wachinger et al., 2015; Albris et al 2020; Satizábal et al., 2022).

Lastly, from the institutional point of view, what emerges is the absence of the provincial/optimal context delegate.

This is not totally surprising. As it was already highlighted in the previous lines, the coexistence of the national and regional level resulted in the weakness of the regional contribution. Moreover, the institution of the optimal context is rather new, and the interviews with regional Civil Protection officers highlighted the difficulties in the implementation of this new territorial boundary. In this smoky scenario, the inclusion of an additional territorial level would have probably resulted in further complexity, without effective positive contribution to the project.

In conclusion, the matrix of Figure 24 well summarizes the situation described above. The Actor-Phase-Activity matrix highlights the vertical and horizontal relationship of the different stakeholders involved, according to their territorial level, showing as well the relation among actors, actions and time. This kind of systemization is useful for displaying competence overlapping, helping each player with the overview of the complete setting to avoid silos thinking and understand if each activity was undertaken at the most appropriate level.

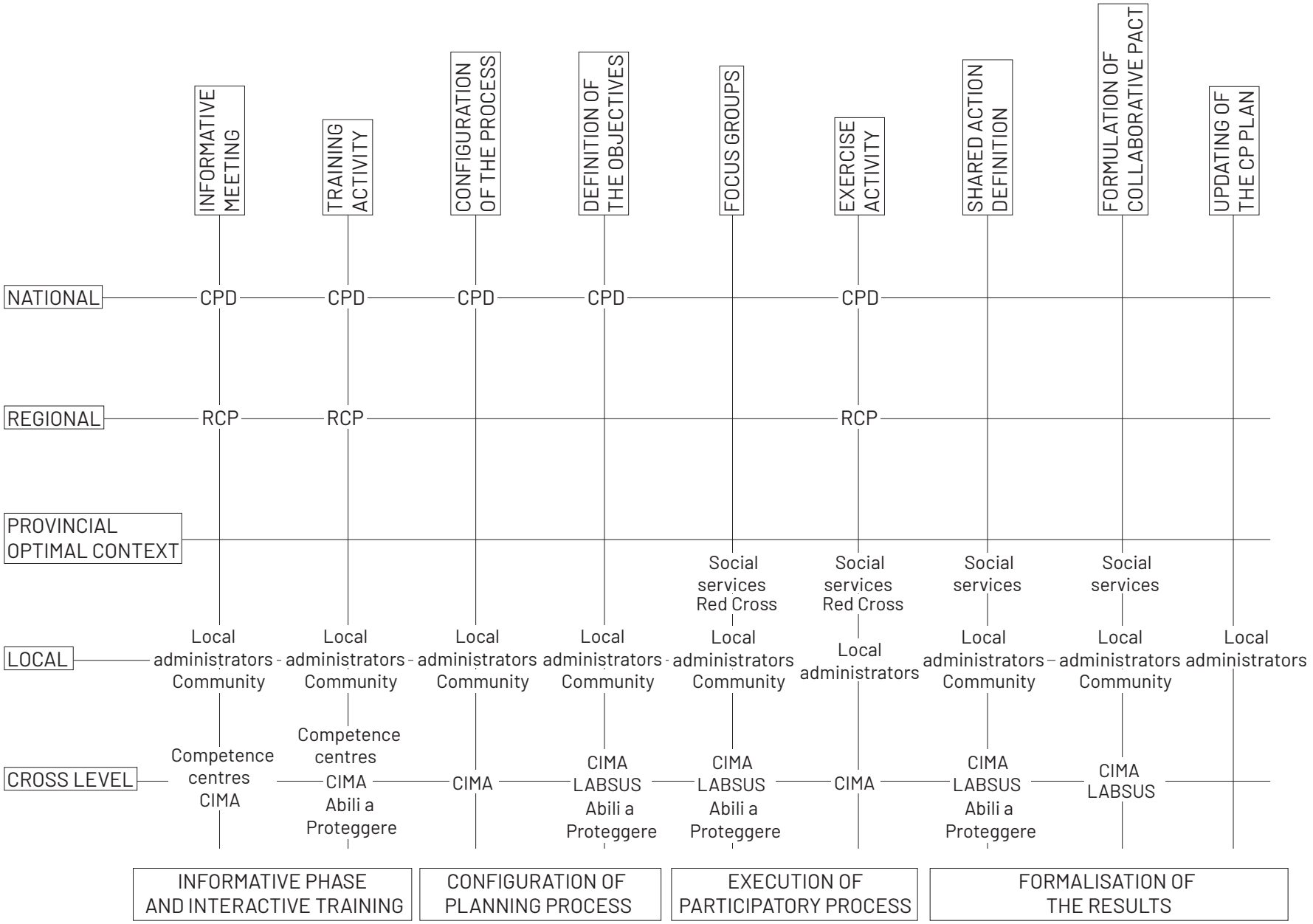

Figure 24. The Actors - phase- activity matrix | Source: Author's elaboration

6.4 Community awareness and Administration's responsibility

The previous paragraph was useful to trace the wide network of stakeholders involved in the process, while now the focus moves to the role played by the community and the effectiveness of its inclusion. Before going deeper into the analysis, a few words must be spent on the composition of the group joining the process and types of the meetings.

The composition of the group taking part in the process changed over time. It was decided to reach the population through the filter of the local associations present on the territory, therefore the municipal administrators made a first mapping of the different associations which could have been interested in joining the project and contacted them. The first exploratory meetings were held in the different hamlets of Bagnara Calabra, hosted within the spaces of the invited associations, to try to reach as much of the population as possible. As said before, in the beginning religious associations played a central role in involving the population for participation (with different levels of participation, depending on various externalities), while later the main participants were associations devoted to the assistance of people with disability and other vulnerable individuals– also due to one of the declared objectives of the process – and associations involved in cultural promotion of the town.

After the first period, the meetings moved to the municipal office (Table 8 - Annex II). The meetings were not held at fixed intervals; they occurred approximately every two months, with breaks during the summer months. *Labsus* acted as mediator of the process and its role was central for the definition of the Collaboration Pact between the associations and the municipal administrators.

The Collaboration Pact is an agreement through which one or more active citizens and a public entity establish the terms of their cooperation for the care of both tangible and intangible common goods (LABSUS, 2023). In this case, Civil Protection activities were considered as intangible common goods and became central focus of the pact. The Collaboration Pact is conceived as a guiding instrument for outlining the commitments of both the administration and the citizens, not only in relation to the revision of the Civil Protection plan but also encompassing a range of complementary activities (Stupazzini, 2023). These include non-structural risk reduction measures directly involving the population, such as the development of risk communication strategies, the implementation of territorial care and maintenance actions, and the formation of a local Civil Protection group.

The stipulation of a Collaboration Pact during a participatory process for Civil Protection planning is an innovation in this field. This can be seen as an attempt to formalize the respective commitments of the parties, especially since the pact includes provisions for monitoring and final evaluation of the process.

The commitments made under the Collaboration Pact are still ongoing, making it too early to render a comprehensive judgment on the instrument. However, it is already possible to make some preliminary observations.

The first success achieved by the Collaboration Pact is the establishment of a mixed working group, composed of people from the associations and municipal administrators, that meets with more or less regular frequency and is tasked with the revision of the plan. This activity is highly educational for all the parties joining the process, as it creates the conditions for equal communication and therefore co-creation of risk-related knowledge. However, the first monitoring carried out from *Fondazione CIMA* on the works of the group[1] showed that the topic of the meeting went in a different direction from the ones defined by the Collaboration Pact.

The objectives defined with the document were principally focused on activities that could be made personally by common citizens (non-technicians): the creation of an informative risk-related pamphlet, the implementation of collective activities for territorial care and maintenance and the creation of a Civil Protection local voluntary group. On the contrary, the attention of the working group was immediately drawn to two highly technical activities: the creation of a synoptic map of individuals with specific needs (such as various disabilities, elderly people, etc.) to be used in emergencies for managing the rescue of the most vulnerable individuals, and the revision of population waiting areas and other strategical areas, as some of those originally designated in the plan were found unsuitable.

While the idea behind the Collaboration Pact was to suggest community intervention on non-technical and non-spatial tasks, the group's efforts quickly refocused attention on territorial and spatial issues within the plan, that had not been considered throughout the rest of the process. Once the plan was placed in the hands of the local population, the focus immediately shifted away from operational/organizational actions to emphasize spatial issues, such as the localization of strategic areas and the mapping activities. The community promptly engaged in cartography and mapping, questioning the localization of strategic emergency areas for reasons of function compatibility, accessibility and risk condition of the selected location. Their local territorial knowledge was crucial to enhance the indications contained in the technical tool.

However, this awareness among the population has highlighted the absence of the municipal administration, which has not assumed responsibility for the issues raised by the working group. A significant problem that has characterized the entire process is indeed the administration's limited involvement regarding technical matters within its competence. So far, this has resulted in the progress and intervention proposals put forward by the working group never materializing into concrete actions. This approach by the municipal administration can prove to be extremely detrimental to the participatory process. In fact, the participatory process should aim to increase citizens' trust in institutions (Scolobig et al., 2015; Albris et al., 2020), particularly with regard to emergency and risk management, but without strong political support and appropriate legal framework, participation might struggle to achieve its objective, triggering the opposite effect (Kuhlicke et al 2011; Oxley, 2013).

1 Monitoring activities began with the signing of the Collaboration Pact and are still ongoing - See Annex II - Table 8

6.5 The impact of the participatory process for DRR

Bagnara Calabra participatory process represented a perfect empirical testing ground for the analysis of the effectiveness of community engagement as a tool for raising risk awareness and improving the willingness to act of both institution and the community.

The analysis of the risk governance system in the Bagnara Calabra participatory process clarified the existing relationship among the different territorial levels. Here again, the issue of competence emerged as central. Retracing the risk governance network made explicit an apparently well-defined system of responsibility, which however gets lost in the myriads of diverse territorial scales encountered during its implementation. An illustrative example is the superposition of role among the National Department of Civil Protection and the Regional Civil Protection (and the absence of the optimal context representatives), as well as the confusion in the definition of the different roles of *Fondazione CIMA, Labsus* and the agencies or competence center which took part in the process. It becomes evident that, ultimately, the local scale is where one can be most effective and impactful in implementing risk reduction strategies. This is especially true in relatively small contexts, such as Bagnara Calabra, where the relationship between administrators and citizens is particularly close.

At the same time, this becomes the reason for the difficulties in the implementation of structural Disaster Risk Reduction strategies. As it was introduced in *Chaper 4,* based on the reflection of Ioannillli (2019), the resolution of the intricate relation between different territorial levels for what concern tools, norms and planning instrument, is not faced at a national level but rather it is designated to local initiatives. This is something which can be controversial to implement by local administrators, that for various reasons are often reluctant to establish long-term programs or implement controversial measures, such as relocations or the imposition of restrictions (Balducci 2019, Menoni 2019).

However, this was not even the case in the context of Bagnara Calabra, because the process never managed to reach the point of definition of structural Risk Reduction intervention.

The participatory process initially experienced a phase of enthusiasm and active involvement from local administrators. However, over time, this commitment gradually diminished, becoming increasingly marginal. Conversely, the community's engagement grew as the project progressed, likely due to an initial misjudgment regarding the associations to involve, which was later on resolved. In this evolution, it might be relevant to start a discussion on the topic of the temporality of these kinds of processes. Participatory processes are inherently slow. For this reason, the opportunity to initiate a participatory process with a newly elected administration represented a favorable starting point for the process's effectiveness. However, due to their slow nature, participatory processes require a certain level of planning and foresight from the proposing institutions—a quality that was evidently lacking in the case of the Bagnara Calabra administration.

It must be highlighted that the process is still ongoing, therefore there could be a twist in the administration's position. Such a shift would be relevant for the positive outcome of the process, as it has become clear that the participatory process can effectively initiate structuring risk reduction measures only if the municipal administration assumes responsibility for the intervention. Otherwise, while the increased awareness within the community about both the general risk conditions affecting Bagnara Calabra and the specific issues of Civil Protection can be seen positively, the attempt to transform emergency management processes into effective Disaster Risk Reduction interventions in spatial planning will ultimately be deemed unsuccessful.

Part III

Planning effectively for Disaster Risk Reduction

The fieldwork experience has demonstrated that emergency management and planning practices observed were unable to trigger effective Disaster Risk Reduction in spatial planning.

In general terms, effective actions of Disaster Risk Reduction are the ones that manage to reduce the levels of hazard, exposure and vulnerability, or increase the capacity of a certain system affected by risk. The complexity in defining the "effectiveness" of such actions derives from the complexity of the system object of intervention and from the difficulties in pre and post intervention risk assessment. What is evident is that DRR actions are strongly context specific and therefore the effectiveness of each intervention must be evaluated in relation to the specific geographical, social and systemic characteristics of the analyzed system.

Paragraph 7.1 The Analysis of the DRR Gaps, explains that the reasons for this inefficacy are partly due to the inability of Civil Protection practices to overcome the DRR Gaps identified in the literature. On the contrary, the case studies analyzed seem to faithfully replicate those models, thereby hindering the smooth transition between the different phases of the disaster cycle.

The results of the selected activities seem to suggest that the impossibility for Civil Protection practices to trigger effective DRR in spatial planning might originate from the incapacity of the latter to embody as central territorial issues such as the evolving territorial knowledge in the case of changing risk scenario, or the centrality of the definition of strategic areas and routes in emergency plans. Both the technical tools, such as the plans, and the practices, including the exercises and participatory processes, as well as the actors involved, have demonstrated an underestimation of the centrality of territorial issues in emergency management.

In all the activities observed the focus is on procedures. The territory often becomes a static framework on which actions are organized. This procedural conception of emergency management and planning prevents the initiation of a discourse on the integration of planning tools, as it effectively denies the existence of all possible common points identified in *paragraph 4.5.1.*

However, *Paragraph 7.2 The role of the planning instruments* explains how, despite the premises, the centrality of spatial considerations still emerged. In this context, this result is even more significant, demonstrating the impossibility of separating spatial issues from discussions related to risk reduction.

Taking into account these premises, *Chapter 8: Fostering Effective Disaster Risk Reduction* tries to propose some guiding principles that can help in the construction of the common foundations for an integrated approach in emergency and spatial planning.

Paragraph 8.1 The DRR database, *an operational proposal*, seeks to add complexity to the proposed disaster cycle model. This operational tool helps in the systematization of connections between stakeholders, information, actions, time frames and data, so at to make explicit the moment in which the continuity of the disaster cycle is interrupted, as well as the possible communication coupling among the different phases.

While *paragraph 8.1* aims at the reconnection of the disaster cycle, *paragraph 8.2 From Emergency planning to Emergency Strategic Program* proposes a change in the planning tools. Recognizing the inefficacy of Civil Protection plans, it proposes transforming the planning tool into a Strategic Civil Protection Program, partially retracing the path of complex programs in urban planning.

7 | Civil Protection Activities: discussion and empirical results

7.1 The Analysis of the DRR Gaps

The two case- studies analyzed in the framework of the Italian Civil Protection system gave an interesting insight into the functioning of a complex and introverted mechanism. They provided empirical evidence supporting the findings in the literature. It is clear that, despite the regulatory changes introduced with the Civil Protection Code, which paves the way for some relatively innovative components for emergency management and planning, we are still far from overcoming the gaps in risk knowledge, risk governance, and risk awareness.

Table 4 well explains both the criticalities and the positive outcomes that emerged.

The SIT DPC in the *EXE Sisma dello Stretto* exercise demonstrated that, although the spatial infrastructure was potentially well-designed, it proved ineffective both as a purely operational tool and, even more so, as a facilitator in the construction of knowledge. In the preparation of the system during the pre-exercise phase, the SIT DPC was used as an uncritical accumulator of data. Then, during the exercise phase, this large volume of data was only partially used. Figure 19 illustrates this process, showing how the knowledge creation process breaks down at the transition between information and knowledge. The absence of an integrated approach to data management undermines the potential for transforming raw data into useful knowledge.

There are some exceptions. The most interesting is the application for the preparation in fully digital mode of the AEDES Sheets on building usability and the implementation in the ERIKUS system. In this case, the spatial infrastructure was built with the clear objective of contextualizing, accumulating, and organizing the data as it was collected, for the creation of the building usability map. The objective was defined from the beginning, as well as the data collection system, the desired output and the actors that would have used that output. This organized process was able to overcome the barriers imposed by the different phases of the disaster cycle, thus facilitating not only the creation of knowledge but also its transfer.

The problems of risk knowledge creation are, however, not solely confined to the technical sphere, especially when considering the issue of informal knowledge and its usability. The participatory process in Bagnara Calabra demonstrated that building the social conditions necessary to foster the creation of informal knowledge

ACTIVITY	RISK KNOWLEDGE CREATION	RISK KNOWLEDGE TRANSFER	RISK AWARENESS	RISK GOVERNANCE
EXE Sisma dello Stretto	No Cross validation of the data No clarity in the output needed Spatial infrastructure still intended as vertical super-position of layers, rather that complex model	Inconsistency of standards in data acquisi-tion, processing and distribution		The exchange of information relies extensively on human capital and informal transfer
Bagnara Calabra participatory process	Lack of opportunities for peer exchange between technicians, administration, and the community	Unclear roles of the technical components of the planning process leads to confusion	The participatory process managed to activate community engagement and involvement Ineffectiveness of the participatory process might lead to loss of trust in institutions	Superposition of competence among different territorial levels Unclear re-sponsability Unwillingness of the local administration to take responsibility for the plan

Table 4. Criticalities and positive outcomes observed in the case study analysis
Source: Author's elaboration

is just as complex as constructing effective digital infrastructures. Communication barriers among technical experts, administrators and the community, along with the extended timeframe of the process, which caused the turnover of participants, posed a challenge. These barriers prevent the establishment of a reciprocal and equitable exchange of knowledge, thus impeding the integration of both formal and informal one.

In terms of risk governance, the case studies reveal ambiguity in the division of responsibilities. In the context of *EXE Sisma dello Stretto*, this lack of clarity has led to the problem of data loss, as in the case related to regional and local Calabria Civil Protection plans revealed by the interviews[1]. Uncertainty about who is responsible for particular tasks or data ownership leads to information gaps during the transition from different phases of the disaster cycle. In Bagnara Calabra, the problem is evident in the territorial division of competences among actors, especially when multiple stakeholders are involved. This includes for example the superposition of roles between the national and the regional Civil Protection level, or the confusion and misconception of the competence of the different stakeholders at the local level.

Lastly, the case of Bagnara Calabra demonstrates that participatory processes can effectively increase risk awareness among the population. Involving the community in planning and decision-making processes enhances public understanding of risks and empowers individuals to take proactive measures, raising the capacity of the community to respond to risk. However, ultimately, the responsibility for structuring intervention falls on local governments, and the level of engagement from local administrators significantly influences the effectiveness of risk governance processes.

What emerges is that the impossibility to overcome these DRR gaps creates fragmentation and complexity in the disaster cycle model, which however still can be considered as a useful lens to read this complexity. The definition of effective intervention of DRR, integrating emergency management and planning and spatial planning, should start from the enrichment of this model with actors, actions, tools and timeframe.

1 From the interviews with Regional and National officers of the Civil Protection emerged that in the handover of the Regional Civil Protection administrative bodies, many data referring to the local Civil Protection Plans were lost. This issue was introduced in the paragraph *5.2 The SIT DPC: Civil Protection Department Spatial Information System*

7.2 The role of the planning instrument

In both analyzed cases, a conception of the planning instrument emerges that is radically different from the one understood in urban planning. Operativity and procedure are the essence of the Civil Protection plan, while territorial issues appear to be of secondary importance.

Historically, the organization of responses to urban risks has followed a protective approach: upon identifying a potential risk, a system is constructed to contain and mitigate it. For example, building banks at locations where a river frequently overflows. This protective strategy has undeniable advantages. By reducing complexity, it simplifies analytical and organizational efforts. However, this approach does not truly eliminate the system's complexity but merely overlooks it; thus, it is effective only for certain categories of events with limited intensity (Bertin, 2018). Such a strategy, however, is inadequate for addressing the complexity of contemporary phenomena, especially given the emergence of increasingly complex risk conditions (Pescaroli and Alexander, 2018).

An alternative model considered is the adaptive one. The adaptive risk management model aligns with the ecological perspective of resilience. This model is conceived as a working methodology, which smartly and continuously adapts to non-linear conditions (Gabellini, 2018). It involves managing the evolution of a phenomenon through a deep understanding of the territory where it occurs and the resources available to mitigate its impact. This approach theoretically underpins the organization of Italian Civil Protection, which dissects problems into specific domains or functions and assigns distinct tasks based on professional expertise (Bertin, 2018).

Nevertheless, this adaptive framework conflicts with the strategies employed in Civil Protection plans, which continue to adhere to protective models. These plans are often highly bureaucratic, providing only partial risk scenarios—partial because they fail to account for the urban system's vulnerability and exposure complexities—and they designate strategic areas and infrastructure locations based purely on quantitative considerations. This creates disconnections between the operators and the instrument due to the incompatibility of these approaches. The plan, as currently conceived, is not an effective tool, a fact demonstrated by the case studies.

In the case of the SIT DPC of *EXE Sisma dello Stretto,* the Civil Protection planning information was scarce and fragmented, and it was not effectively utilized by the emergency management operators. This is evidenced by the fact that, according to the Civil Protection exercise procedures, a specific function should oversee Plan control—a role that, as revealed by interviews, was not fulfilled.

In the case of the participatory process in Bagnara Calabra, the distinction between the presence and absence of the instrument is blurred. The process is theoretically centered around the plan, beginning with the objective of updating the Civil Protection plan. However, the plan is elusive, or perhaps only certain aspects are considered. The focus is much more on procedures than on other aspects. Efforts

concentrate on operationality and procedures in emergencies, responsibilities in emergency management, equipment, and alarm systems. The plan is viewed solely in its procedural dimension, with a complete lack of spatial consideration. Given the evolution of Civil Protection and the nature of the Civil Protection plan, this procedural focus should not be surprising. Even the Augustus method aims to organize emergency management operations in a context where the territory is seen as a collection of resources and equipment rather than a site for specific actions.

This procedural perspective is also evident during interviews with Civil Protection operators and *Fondazione CIMA* technicians. The identification of strategic areas and routes is driven purely by calculation. Suitable areas are those with adequate surfaces, preferably public spaces. However, this approach shows significant limitations, since it reproduces in the realm of risk, the criticalities that might be already present in the urbanistic sphere, such as the lack of accessible and adequate public spaces. Working solely with existing resources through Civil Protection plans prevents addressing the criticalities that emerge during the process in a structural and strategic manner. This issue was particularly evident in the town of Bagnara Calabra, where entire neighborhoods are located in areas of high hazard level, with no adequate public spaces nor strategic emergency areas. An example is the Marinella neighborhood, the fishing district on the north side of the Marturano cliff, an area prone to seismic, hydrogeological, tsunami, and fire hazards. This situation is further exacerbated by socio-economic conditions and the quality of buildings, many of which are illegal constructions without connection to the municipal sewage system. The planning document highlighted the high level of risk in the area, and this was even more evident with the development of the participatory process. It is in this kind of situation that the necessity for collaboration between emergency planning and spatial planning emerges. Indeed, it would be impossible to lower the level of risk in Marinella, without a holistic approach facing social, economic, urbanistic and risk issues.

On a positive note, while Civil Protection operators view the plan only from a strategic perspective, and administrators, either out of convenience or necessity, overlook the spatial issues related to the plan, the community has immediately brought these issues to the forefront. This is likely because the procedural aspects of Civil Protection were not necessarily comprehensible to them, whereas the territorial and spatial dimensions of the plan were part of their environment, something they recognized and felt empowered to influence. In both cases, the outcome of the process demonstrates that spatial issues (such as the location of public spaces, the definition of safe routes, the management of strategic areas...) can become fertile ground for initiating dialogue between the parties.

8 | Fostering effective Disaster Risk Reduction

8.1 The DRR database, an operational proposal

The work here presented has made explicit the complexity of the functioning of the Disaster Risk Reduction mechanism; gaining a comprehensive and global perspective of the interdependencies of the diverse systems poses a challenge.

In order to try to propose a systemization of this complex scenario, the elaboration of the information collected during the analysis of the case studies is performed through the construction of a DRR relational database, where the processes observed are made explicit in the form of entities and relations.

The main purpose of this relational database, enhancing the model of the disaster cyle, is to systemize the processes of Disaster Risk Reduction, making explicit the connections between stakeholders, actions, data and timeframe, to optimize the transmission of knowledge risk-related along the diverse phases of the disaster cycle, as well as identify clearly each stakeholder's competence.

The database has been implemented using Microsoft Access, a software for relational database management, part of the Microsoft Office Suite 2021. Microsoft Access is a proprietary software, available only for Windows. The decision to use this type of software was justified by its wide diffusion and its ease of use. Indeed, the configuration of Microsoft Access allows, in the case of simple databases such as the one developed in the research work, the use of certain templates included in the software package that allow the creation and querying of the database without the need to use programming languages. Obviously, the physical implementation of the database is not linked to a single software, so the logical model presented can be developed with any DBMS – Database Management System.

This database needs to be simple – but not simplistic – dynamic and interoperable. Starting from a general implementation, it needs to evolve together with the DRR discipline, therefore allowing the inclusion of new entities, relations and attributes, continuously communicating with other information systems and platform.

The effectiveness of the database as instrument for simplifying the interrelations along the disaster cycle will be tested in two specific use cases, representative of the connection among the different phases of the disaster cycle.

The first use case refers to the response phase and aims at connecting input

data with output products, making explicit the ownership of the data as well as the platform in which they are organized. Two are the queries executed, one related to the post-earthquake building usability plan and the other related to the flooded areas after a tsunami wave. The second use case is focused on the link between response and recovery, showing how the information created during emergency management can be implemented in policies and plans.

This database has been developed starting from the observation and data gathered during the fieldwork, meaning that it considers the case of a national relevance disaster event, in which the control on the territory affected is taken over by the Civil Protection Department, with the consequent opening of the DICOMAC, due to the impossibility of local government to cope with the situation. It is central to stress this, since not all emergencies need the intervention of the national level, but having showed the most complex scenario is instrumental for the specific purpose of this database, that, despite presenting just a selection of specific examples, is thought as explicative for the wider understanding of the process described. It aims at going beyond the description of the emergency management phase, becoming a model that can be extended to the whole disaster cycle.

Figure 25 gives an overview of the conceptual model of the database, showing classes and relations among them. This organization is based on what has been observed in the fieldwork, as well as on the structure of the Civil Protection System that was explained in chapter 4. The meanings of the different classes are explained in table 6, while table 7 clarifies the relations among them.

Attributes and specific relationships between the various classes are deepened in detail in the logical data model (Figure 26), in an application independent way. Each class presents a numerical primary key identified with the prefix {id}. Database is not only used to explicit relations, but also to store information. Therefore, attributes that complete each class of the database cover a crucial role for the completeness of the model.

As for the *data class*, the information about the record is completed with the attributes “detection_method”, “date_acquisition”, and “type”. These three adjunct elements complete the information related to the data, giving insight on the different methods of data detection, the date of acquisition of the data and the type of data stored.

Relevant attributes can also be found in the *output class*, such as “output_type” and “output_level”. As for the first, differently from the data, it does not refer to the data format, but instead to the typology of product that is created starting from the input data, as for instance a cartography, a plan of a text document. Instead, the output level describes the number of processing that the product has undergone, starting from level L1 – in case of an output directly coming from raw data – and continuing on levels L2, L3… Output products of one phase can, in fact, become input data for the following one, since data and output are connected by a recursive relation that updates over time.

Referring to the *stakeholders class*, one significant information is represented by the “stakeholder_type”. This attribute defines whether the element is a constituent

of the Civil Protection service or an operating structure, based on the classification of the Civil Protection Code.

An important role is covered by the *timeframe class*, since it is the class that permits to organise with a coherent and systemic method all the different element that intertwine the disaster cycle.

For the moment, *platform class* and *action class* only contain attributes related to the description of the corresponding element, as it is in the aim of this work to leave the database as straightforward as possible. However, this model is though as an open database, suitable for different scenarios, therefore it is possible to modify the structure of the classes in case of need.

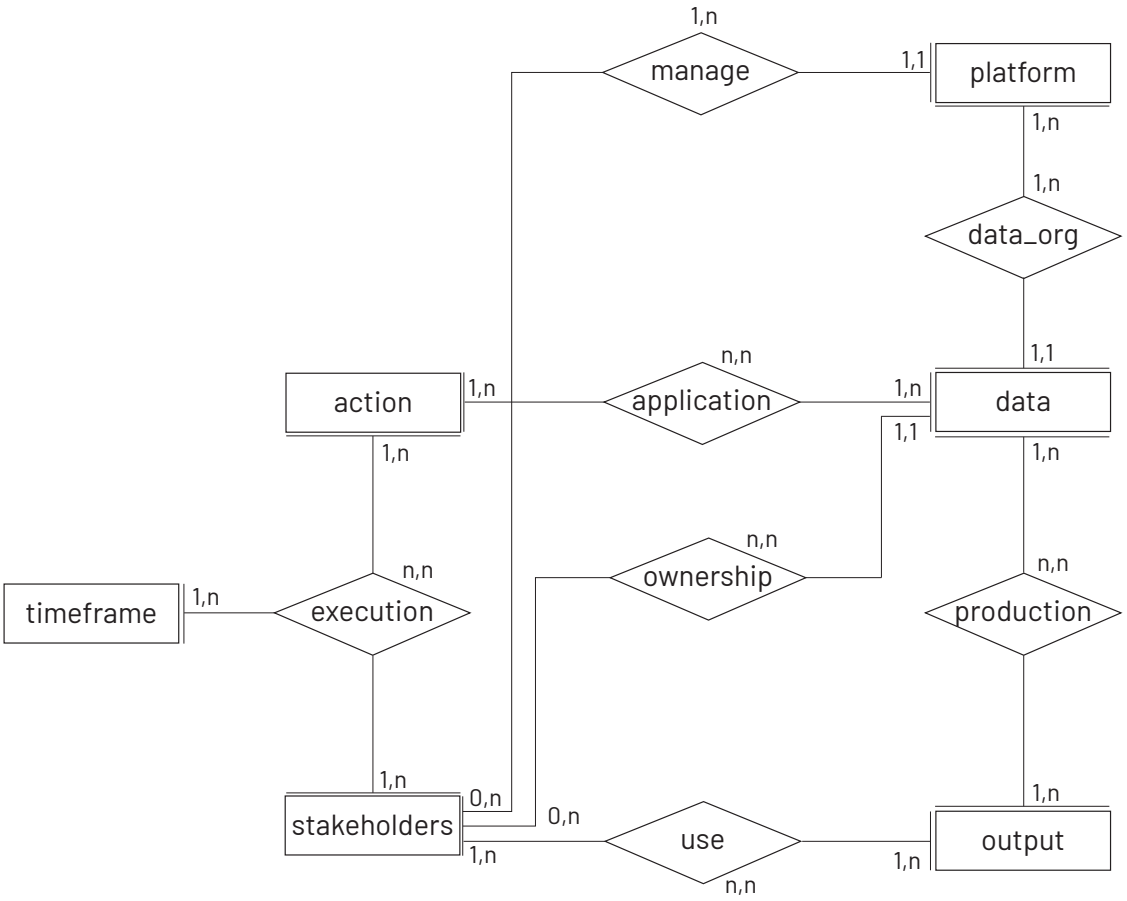

Figure 25. The conceptual data model of the Disaster Risk Reduction database.

Classes are represented in squared boxes, while relations are represented in diamond boxes. This kind of systematization is useful for the analysis and management of the relations of all the different elements that belong to the Disaster Cycle.

Source: Author's elaboration

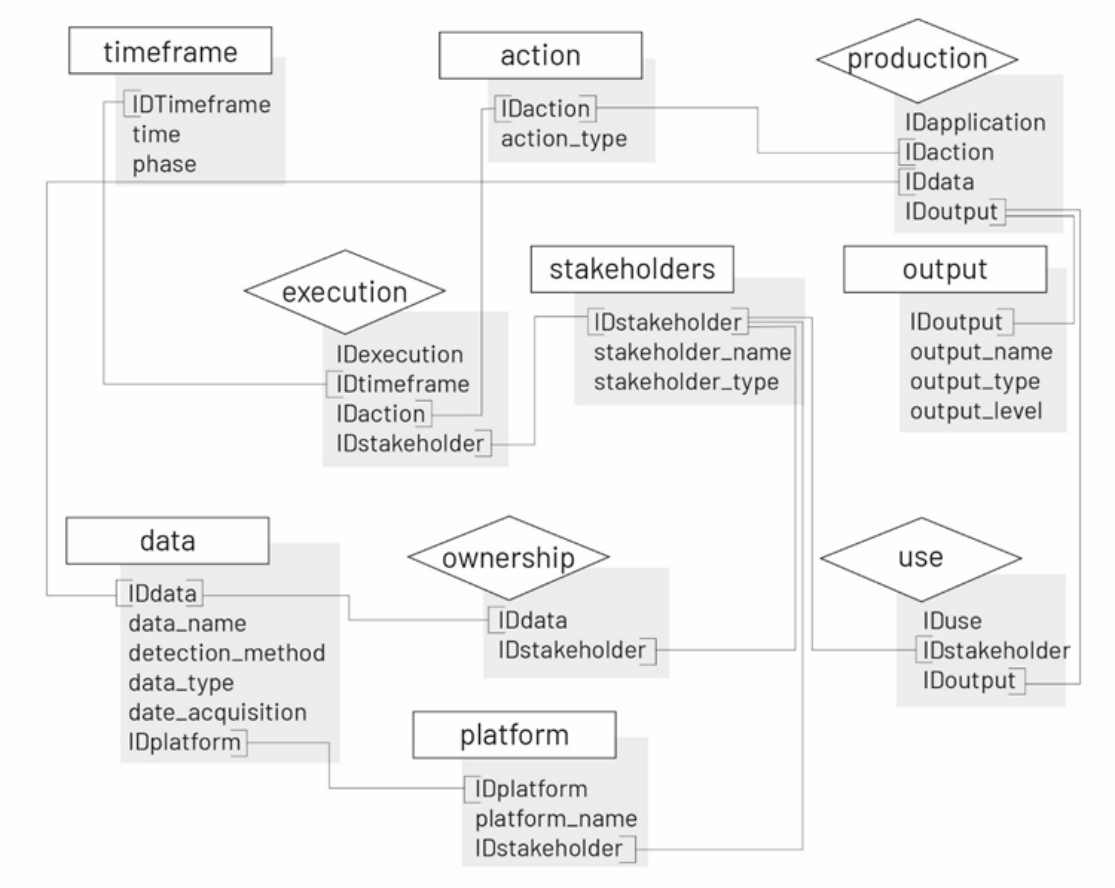

Figure 26. Logical Model of the Disaster Risk Reduction Database
Source: Author's elaboration

Classes of the database	
Class Name	**Description**
Timeframe	Includes the different phases of the disaster cycle
Stakeholders	Include all the different stakeholders involved at the different territorial level
Action	Include procedures and activities
Platform	Include the spatial and non-spatial information systems
Data	Include input data coming from different sources
Output	Include the products created after the processing of the data

Table 5. Classes of the Disaster Risk Reduction Database
Source: Author's elaboration

Relations of the database	
Relation	**Description**
Execution	Relation between timeframe, stakeholders and actions
Manage	Define the stakeholder who is in charge of the platform
Application	Connects the data with the corresponding action
Ownership	Define the property of the data
Use	Define which are the stakeholders that utilize the output created
Data_Organization	Describe how the data are organized into the platforms
Production	Connects the data with the corresponding outputs

Table 6. Relations of the Disaster Risk Reduction Database
Source: Author's elaboration

Use case n.1: Response phase

The first use case is framed in the response phase and aims to explicit the connection between input data and output products, ownership of the data and management of the platform. It will be shown through two queries, also thought to display the recursive relation between input data and output products.

These examples are based on the observation collected during the *EXE Sisma dello Stretto* exercise, and therefore are related to two explicative outputs that might be needed in case of emergency management after an earthquake and a tsunami: ***the post-earthquake building usability map*** and ***the flooded area map***.

As for the first, the post-earthquake building usability map is a cartography that represents the state of building after a seismic event. It indicates the state of the ordinary structural type buildings for housing and/or services, based on the AEDES sheets, compiled by technical practitioners (architects, engineers) after an expeditious survey. During the *EXE Sisma dello Stretto* exercise it was tested the interoperability of the ERIKUS and Agitec systems, for the drafting of the AEDES sheets in a fully digital mode, implementing all the different systems in the SIT DPC.

This first query aims at answering those questions:

- **Which are the data used for the drafting** *[of the post-earthquake building usability plan]*[1]***?***
- **Who owns the input data used for** *[the post-earthquake building usability plan]**?***
- **Which are the platforms through which the input data are managed?**

Figure 27 represents the logical model of the query, showing the relations between the different classes involved. As it can be seen by the results of the query, some of the input data needed for the building usability map are themselves output from a previous activity, i.e. the technical survey plan. Changing the subject of the query, it is possible to trace all the raw input data necessary for the different steps (Figure 28 and Figure 29).

1 Square brackets are used to indicate the information that are specific to the use case here analysed, but that might be modified accordingly to different queries.

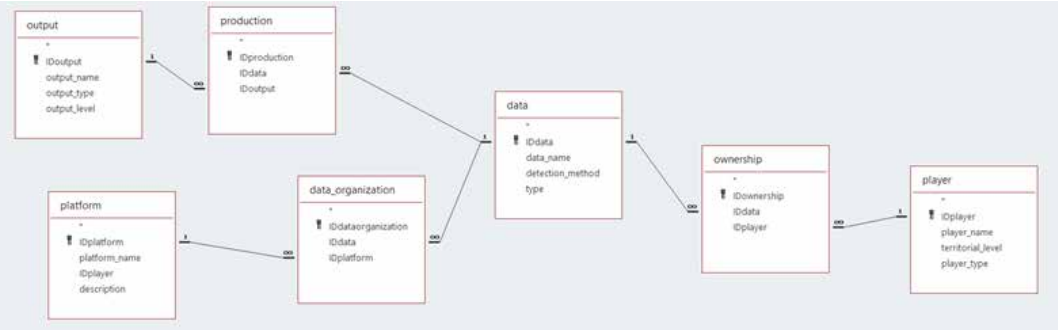

Figure 27. Logical model of the query for the post-earthquake building usability map
Source: Windows Access Application

building usability	grading CEMS	EU - Copernicus Programme	CEMS
building usability	L2_technical survey plan	Civil Protection Department	SIT DPC
building usability	AEDES sheet	technical practitioner	agitec
building usability	Event scenario	Civil Protection Department	SIT DPC

Figure 28. Results of the query.
Source: Windows Access application

output_name	data_name	player_name	platform_name
infrastructure damage	built up	Civil Protection Department	SIT DPC
infrastructure damage	infrastructure	Civil Protection Department	SIT DPC
infrastructure damage	reports from population	Civil Protection Department	SIT DPC
infrastructure damage	INGV value	functional centre	earthquake catalog
infrastructure damage	RAN value	Civil Protection Department	SIT DPC
technical survey plan	L1_infrastructure damage	Civil Protection Department	SIT DPC
technical survey plan	L1_urban centre damage	Civil Protection Department	SIT DPC
technical survey plan	grading CEMS	EU - Copernicus Programme	CEMS
building usability	grading CEMS	EU - Copernicus Programme	CEMS
building usability	L2_technical survey plan	Civil Protection Department	SIT DPC
building usability	AEDES sheet	technical practitioner	agitec
building usability	Event scenario	Civil Protection Department	SIT DPC

Figure 29. Complete list of the input data necessary for the building usability map.
Source: Windows Access application

The second example of this first use case is related to the flooded area map after a tsunami. This example has been selected because it is explicative of the functioning of the database at different times, demonstrating how the recursive relation between input data and output product works.

This query aims at answering this question:

- **Which are the input data needed for the drafting** *[of the flooded area map after a tsunami wave]* **at a certain time?**

For the purpose of this example, three timeframes will be considered. First, the scenario map at T-1, before the event, showing the area potentially susceptible to tsunami flooding. Then, two flooding area maps at two different times, time T1 just after the event (few hours) and time T2 after the activation of the DICOMAC, that usually happens one or two days after the event, in order to monitor the water that begins to recede. Each map will consider as input data information coming from the previous output product.

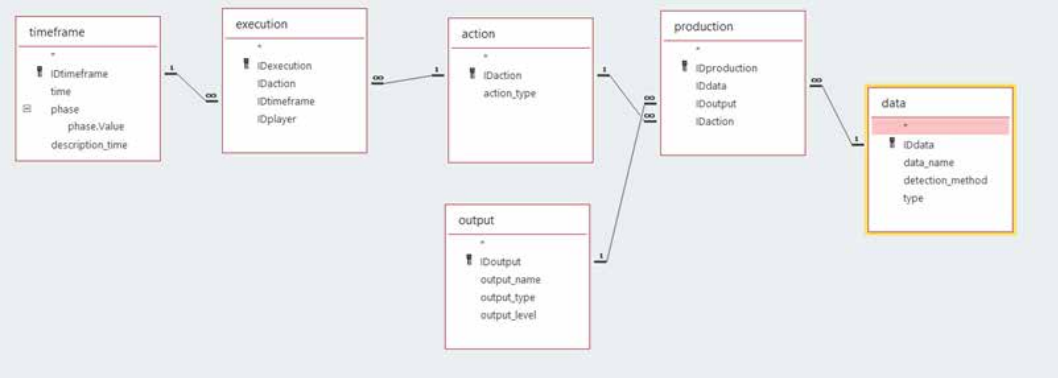

Figure 30. Logical model of the query for the flooded area map
Source: Windows Access Application

phase	Time	action_type	output_name	output_level	data_name
preparedness	T-1	definition of evacuation areas	susceptible flooded area	L1	hydrogeological management plans
preparedness	T-1	definition of evacuation areas	susceptible flooded area	L1	urban masterplan
preparedness	T-1	definition of evacuation areas	susceptible flooded area	L1	land use
preparedness	T-1	definition of evacuation areas	susceptible flooded area	L1	SIAM warning zone
preparedness	T-1	definition of evacuation areas	susceptible flooded area	L1	special needs people
preparedness	T-1	definition of evacuation areas	susceptible flooded area	L1	population density
preparedness	T-1	definition of evacuation areas	susceptible flooded area	L1	civil protection plans
preparedness	T-1	definition of evacuation areas	susceptible flooded area	L1	infrastructure
preparedness	T-1	definition of evacuation areas	susceptible flooded area	L1	built up

Figure 31. Results of the query at the time T-1
Source: Windows Access Application

First, the query is launched at the time T-1, in the preparedness phase before the happening of the event. Figure 30 shows the result of the query. As it can be read in the table, input data are of different nature and include both raw data (as the population density or the localization of the infrastructure), elaboration coming from model, as the SIAM warning zones, and planning documents. The drafting of the susceptible flooded areas is, in this specific example, aimed at the definition of the areas to be evacuated in case of a tsunami, and therefore it is necessary to consider not only physical assets but also norms and restriction affecting the area.

phase	Time	action_type	output_name	output_level	data_name
preparedness	T-1	definition of evacuation areas	susceptible flooded area	L1	civil protection plans
preparedness	T-1	definition of evacuation areas	susceptible flooded area	L1	land use
preparedness	T-1	definition of evacuation areas	susceptible flooded area	L1	SIAM warning zone
preparedness	T-1	definition of evacuation areas	susceptible flooded area	L1	special needs people
preparedness	T-1	definition of evacuation areas	susceptible flooded area	L1	population density
preparedness	T-1	definition of evacuation areas	susceptible flooded area	L1	infrastructure
preparedness	T-1	definition of evacuation areas	susceptible flooded area	L1	built up
preparedness	T-1	definition of evacuation areas	susceptible flooded area	L1	urban masterplan
preparedness	T-1	definition of evacuation areas	susceptible flooded area	L1	hydrogeological management plans
response	T1	definition of affected systems	flooded area	L2	post event images
response	T1	definition of affected systems	flooded area	L2	Delineation CEMS
response	T1	definition of affected systems	flooded area	L2	reports from population
response	T1	definition of affected systems	flooded area	L2	L1_Susceptible flooded area

Figure 32. Results of the query at the time T1
Source: Windows Access Application

Figure 32 shows the results of the query launched at the time T1, few hours after the – simulated – tsunami wave. In this case the output is the actual flooded area, useful for the definition of the affected systems and the activation of the related protocols. Among the input data of the flooded area map, there are the information coming from the susceptible flooded area, which thus forms the reference level for the drafting of the top-level map, including all the raw data contained in the lower-level output.

phase	Time	action_type	output_name	output_level	data_name
preparedness	T-1	definition of evacuation areas	susceptible flooded area	L1	hydrogeological management plans
preparedness	T-1	definition of evacuation areas	susceptible flooded area	L1	infrastructure
preparedness	T-1	definition of evacuation areas	susceptible flooded area	L1	civil protection plans
preparedness	T-1	definition of evacuation areas	susceptible flooded area	L1	population density
preparedness	T-1	definition of evacuation areas	susceptible flooded area	L1	special needs people
preparedness	T-1	definition of evacuation areas	susceptible flooded area	L1	SIAM warning zone
preparedness	T-1	definition of evacuation areas	susceptible flooded area	L1	land use
preparedness	T-1	definition of evacuation areas	susceptible flooded area	L1	built up
preparedness	T-1	definition of evacuation areas	susceptible flooded area	L1	urban masterplan
response	T1	definition of affected systems	flooded area	L2	Delineation CEMS
response	T1	definition of affected systems	flooded area	L2	post event images
response	T1	definition of affected systems	flooded area	L2	L1_Susceptible flooded area
response	T1	definition of affected systems	flooded area	L2	reports from population
response	T2	monitoring of the flooded area	flooded area_t2	L3	L2_flooded area
response	T2	monitoring of the flooded area	flooded area_t2	L3	reports from population
response	T2	monitoring of the flooded area	flooded area_t2	L3	Delineation CEMS
response	T2	monitoring of the flooded area	flooded area_t2	L3	post event images

Figure 33. Results of the query at the time T2
Source: Windows Access Application

Lastly, the final iteration of the query is launched, showing again how the third level output, is built on the information processed in the previous phases (Figure 33).

What is interesting to highlight in this particular timeframe is the role of the stakeholders involved. According to the example, time T2 starts after the activation of the DICOMAC, and therefore of the activation of the different Function in which the Civil Protection Emergency management service is organized.

This means that, while a certain output is necessarily produced by a single stakeholder, many different players can then use that specific product. Figure 32 shows practically what explained in the previous lines, using the example of the Flooded Area map produced by the Technical Function at time T2, for monitoring purpose, but used by many different functions according to their specific objectives.

This example answers to the question:

- **Who are the stakeholders that use the** *[flooded area map]* **at the** *[T2 time]***?**

Changing the timeframe, using T1 time, thus considering the associated output, results show that the flooded area map is used by Civil Protection Department together with other actors included in response phase. This is because in this specific phase of the emergency management process, the activation of functions has not yet taken place and decisions - for events of national importance such as the one considered in the example - are still taken by the Civil Protection Operations Committee, composed – among others – by the actors present in the Figure 34. This example is useful to highlight the dynamicity of the composition of stakeholders that take part in the emergency management process, which change with the evolution of the event management process, including not only components of the Civil Protection structure but also external ones.

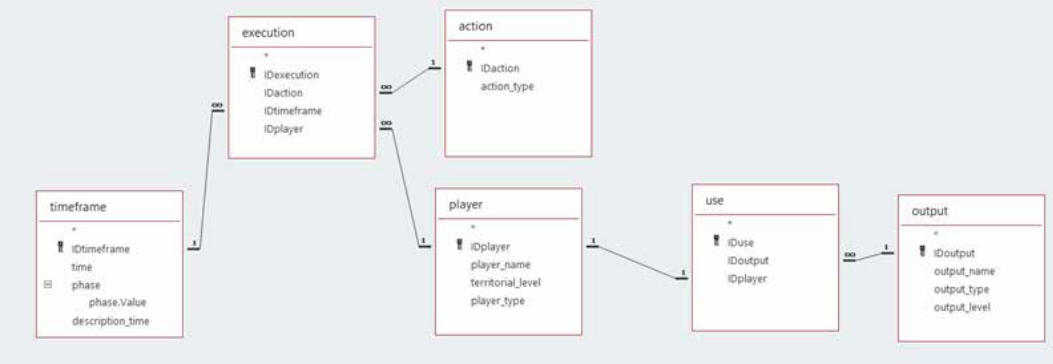

Figure 34. Logical model of the query for the stakeholders that use the flooded area map
Source: Windows Access Application

phase	Time	output_name	action_type	player_name
response	T1	flooded area	definition of affected systems	Local Government
response	T1	flooded area	definition of affected systems	Fire Department
response	T1	flooded area	definition of affected systems	Regional Civil Protection
response	T1	flooded area	definition of affected systems	Civil Protection Department
preparedness	T-1	flooded area	definition of evacuation areas	Local Government
response	T2	flooded area_t2	check of available shelter areas	emergency infrastructure function
response	T2	flooded area_t2	count of evacuated people	population assistance function
response	T2	flooded area_t2	assessment of infrastructure operativity	damage survey and post-event operability function
response	T2	flooded area_t2	monitoring of the flooded area	technical function and induced risk assessment

Figure 35. Use of the flooded area map by different stakeholders at different timeframes.
Source: Windows Access Application

Use case n.2: the link between response and recovery

The second use case is chosen to highlight the connection that intervene between the response and the recovery phase. The objective is to trace the process of knowledge creation risk-related that occur during emergency management and, afterwards, to explicit the chain of actions related to the updating of the planning instruments that use risk-related information.

Once again, the specific example highlighted in this section is based on the observation conducted during the EXE Sisma dello Stretto, taking as specific use-case the activity of monitoring and mapping of new landslides induced by the seismic event, carried out by the technical function and induced risk assessment division. The example here presented answer to these questions:

- **How can the information processed for the** *[landslide hazard map, created in the response phase]* **be implemented in the recovery one?**
- **Who are the stakeholders in charge of the process at a certain time?**

Figure 35 represents graphically the process of knowledge transfer along the response and recovery phases, stressing how the diverse steps interface with the disaster cycle. In this case, the query is structured as the one related to the flooded area map, only changing the object of the request.

What appears evident from the analysis of the query results is the continuity between one phase and the other, given by the fact that the output products of the response phase become key input data for the recovery one. Moreover, one relevant element to focus on is the change in the composition of the stakeholders involved in the activity throughout the different steps. While in the T2 Response phase the competence is still in the hand of the technical function and induced risk assessment, that operates in the context of the DICOMAC, in the following response phase the competence is taken over by local administration and territorial authority. Moving from emergency management to ordinary territorial governance, the exceptional powers, enabled by the state of emergency, revert to the jurisdiction of administrative stakeholders.

data_name	action_type	Time	phase	player_name	output_name
RAN value	monitoring of induced landslide events	T2	response	technical function and induced risk assessment	landslide hazard map
built up	monitoring of induced landslide events	T2	response	technical function and induced risk assessment	landslide hazard map
infrastructure	monitoring of induced landslide events	T2	response	technical function and induced risk assessment	landslide hazard map
reports from population	monitoring of induced landslide events	T2	response	technical function and induced risk assessment	landslide hazard map
INGV value	monitoring of induced landslide events	T2	response	technical function and induced risk assessment	landslide hazard map
Delineation CEMS	monitoring of induced landslide events	T2	response	technical function and induced risk assessment	landslide hazard map
Event scenario	monitoring of induced landslide events	T2	response	technical function and induced risk assessment	landslide hazard map
in situ technical survey	monitoring of induced landslide events	T2	response	technical function and induced risk assessment	landslide hazard map
land use	monitoring of induced landslide events	T2	response	technical function and induced risk assessment	landslide hazard map
post event images	monitoring of induced landslide events	T2	response	technical function and induced risk assessment	landslide hazard map
hydrogeological management plans	monitoring of induced landslide events	T2	response	technical function and induced risk assessment	landslide hazard map
hydrography	monitoring of induced landslide events	T2	response	technical function and induced risk assessment	landslide hazard map
L2_landslide hazard map	updating of the hydrogeological management plans	long term	recovery	basin authority	hydrogeological management plans (new)
L2_landslide hazard map	updating of the civil protection plan	long term	recovery	Local administration	civil protection plan (new)
L2_landslide hazard map	updating of technical norms and constraints	long term	recovery	Local administration	technical norms and constraints (new)

Figure 36. Results of the query for the use case n.2
Source: Windows Access Application

8.2 From emergency planning to strategic emergency program

The DRR database presented in the previous paragraph conceptually models the functioning of the DRR process, starting from the phased model introduced with the disaster cycle. It seeks to address some of the issues that have emerged, particularly regarding the clear identification of roles, competencies, and objectives of actions.

However, the database inevitably carries with it all the limitations of the tool, and therefore needs to be complemented by concrete actions involving the stakeholders responsible for risk reduction in the various phases.

Building on the considerations outlined so far, the research acknowledges the inefficacy of Civil Protection practices and their planning tools, both - partially - as emergency management tools and as risk reduction tools. It proposes a transition from the Civil Protection plan to a strategic Civil Protection program.

This transition, which partially mirrors the path undertaken following the crisis of urban planning in the 1990s (Barbanente, 2002 , Saccomani, 2004, Gabellini, 2018), envisions the strategic Civil Protection program as a programmatic tool, a container of complementary instruments that include both non-spatial (operational) and spatial components.

Similar to complex programs, the strategic Civil Protection program should be based on the concepts of integration, consultation, and negotiation.

The concept of integration would allow for the coexistence of actions that are very different in form, sector, and type, enabling Civil Protection practices to harmonize procedural and planning dimensions.

Moreover, the concept of consultation/negotiation is even more central, as it implicitly involves the presence and collaboration of diverse actors, both public and private. This would compel administrators and technicians to engage in co-designing emergency management and planning actions, fostering the clarification of roles and competencies, and laying the groundwork for genuine communication between stakeholders.

This approach to emergency management and planning can be implemented at all different territorial levels and would also promote the exchange between Civil Protection actors and territorial governance actors operating at the same territorial levels.

Strategic Civil Protection programs will continue to include both a procedural component and a planning component. However, both must be improved and integrated, particularly in the following areas:

Composition of the working group

The strategic Civil Protection program must include all stakeholders involved in defining effective risk reduction strategies and emergency management. Among

these, the role of the urban planner is essential. Being emergency management and planning and DRR a spatial issue, it is necessary to address them integrating the territorial, political and social dimension. The new Civil Protection program must thus incorporate a strong territorial-based strategic vision.

Following the model of other planning tools - both at the regional scale, such as landscape plans, and at the local scale - collaboration with universities and research institutions should be encouraged. This would enhance the definition of risk scenarios, for instance, through the use of innovative multi-risk assessment strategies.

Program Monitoring, Review, and Adaptation

Strategic Civil Protection programs must be periodically monitored and evaluated, particularly after natural disasters or non-structural risk reduction actions such as Civil Protection exercises.

The analyses described in the present work have demonstrated that Civil Protection emergency management largely relies on the tacit knowledge of its operators. Regularly initiating review processes, either periodically or in response to specific events, would help practitioners, administrators, and Civil Protection officers to gain deeper insights, improve their practices, and prepare for future challenges. This would also help in transforming tacit knowledge - unspoken, intuitive understandings - into explicit knowledge that can be shared and taught (Schön, 1983).

The methodologies for monitoring and evaluation must also be explicitly outlined in the strategic Civil Protection program. Although the technical annex to the Plans Directive provides general guidelines on plan monitoring and evaluation, they have not been implemented due to the lack of formalized methods.

Regional governments need to prepare documents and guidelines for plan monitoring, emphasizing the need to formalize the lessons learned following significant events.

Community Participation

Community participation processes must be driven by clear and well-defined objectives. The duration of these processes should be predetermined—potentially as part of a shared decision-making process—and communicated at the beginning of the process to ensure all participants understand the timeline.

At the local level, these processes should be structured as continuous and structuring actions, alternating between training and project moments that are tailored to local specificities. The design of methods and approaches for participatory processes should be among the goals of the strategic program. This approach benefits both the population and the administration, as it lays the foundation for genuine co-production of knowledge and increases trust in institutions. Moreover, continuous training processes would help create a shared language between the administration, community, and technical experts.

Finally, participatory processes with the population must also include the territorial component of the Civil Protection program.

The informal knowledge of the community that inhabits a specific area can enrich the definition of both the territorial framework and the intervention model of the plans. The methods and tools for involving the population in territorial issues vary significantly depending on the scale of reference. These range from large-scale participatory mapping projects, potentially at the regional level, to more localized activities with individual communities.

Conclusion

The study presented here is framed in the general discourse on Disaster Risk Reduction, focusing the attention on the relation between emergency management, emergency planning, and spatial planning.

The research tries to answer the question of *"How can emergency management and planning trigger effective Disaster Risk Reduction in Spatial Planning"*, delving into the analysis of Civil Protection practices and activities and questioning if and how they could trigger structuring action of risk reduction.

The project is structured around two guiding hypotheses. The first posits that spatial planning plays a central role in all four phases of the disaster cycle, including the emergency-related phases of preparedness and response. Various aspects of spatial planning can significantly enhance emergency planning, facilitating rescue operations (e.g., improving connections between strategic assets and infrastructures) and bolstering the recovery of disaster-affected territories and communities. The second hypothesis suggests that emergency planning should not be viewed merely as an operational activity or a static goal but rather as a process that includes governance implications and strategic territorial perspectives. The focus should be on the planning process itself, as it connects the different components of the disaster cycle.

By focusing on the emergency-related phases of the disaster cycle, considering the complexity of DRR, and incorporating the multiplicity of stakeholders and instruments involved, the research aims at defining practices, tools and areas of intervention that can initiate a process of integration between spatial planning and Civil Protection planning.

This objective is pursued through a case-study methodology, analyzing two specific activities of the Italian Civil Protection: the national Civil Protection exercise, *EXE Sisma dello Stretto*, and the participatory process for drafting the Civil Protection plan in Bagnara Calabra. These activities represent key moments in the disaster cycle and are essential for describing a bounded system like the Civil Protection. The combination of these experiences generates context-dependent knowledge that addresses the DRR gaps identified in the theoretical framework.

The findings from the fieldwork have effectively mirrored the critical categories delineated in the existing literature, offering empirical support for the theoretical framework.

With respect to the *EXE Sisma dello Stretto* exercise, an analysis of the structure and functionality of the SIT DPC revealed that the implementation of a Spatial Data Infrastructure is still inadequate in bridging the gaps related to risk knowledge generation and dissemination. This proved ineffective both as a purely operational

tool and, even more so, as a facilitator in the construction of knowledge. This inadequacy arises from both technical and procedural challenges.

The tool has yet to be integrated into the daily operations of many stakeholders involved in emergency management, resulting in a suboptimal utilization of its capabilities. Furthermore, the absence of an integrated approach to data management undermines the potential for transforming raw data into useful knowledge Regulatory advancements, particularly the inclusion of the digital plan in the new Civil Protection Code, indicate a clear intention to progress toward a comprehensive digital transition, though this endeavor remains in its early stages. Furthermore, the examination of procedures indicated that both informal and professional knowledge continue to play a pivotal role, underscoring the significance—and challenges—of human capital in the processes of knowledge transmission.

In the context of the participatory process in Bagnara Calabra, he mapping of the participating actors highlighted the complexity of the risk governance system, particularly when the entire spectrum of territorial levels - from national to local - are engaged. It became apparent that frequent overlaps in competencies can create confusion regarding the allocation of responsibilities, and that clearly defining the roles of each participant - whether institutional or technical - can aid in establishing effective communication channels that promote the exchange of both formal and informal knowledge among the parties. Also, the case of Bagnara Calabra demonstrates that participatory processes can effectively increase risk awareness among the population. Engaging the community in planning and decision-making processes not only improves public awareness of risks but also empowers individuals to take proactive measures, thereby enhancing the community's capacity to respond. Nonetheless, the ultimate responsibility for structuring interventions rests with local governments, and the degree of involvement from local administrators plays a crucial role in determining the effectiveness of risk governance processes. Unfortunately, the municipal administration's response was not as encouraging as it struggled to assume responsibility for the plan. This reluctance risks undermining trust in the institution, ultimately countering the objectives that participatory processes aim to achieve.

Evidence from the analysis seems to suggest the inability of Civil Protection practices and planning instruments to introduce effective intervention of DRR in spatial planning.

This situation can be attributed, in part, to the limitations of Civil Protection practices in addressing the gaps in Disaster Risk Reduction identified in existing literature. Additionally, there is a failure to acknowledge the crucial role that territorial issues play in emergency management and planning, which directly impacts DRR efforts. While operational and procedural aspects are fundamental to the Civil Protection plan, territorial considerations tend to be regarded as secondary, undermining the effectiveness of overall risk management strategies. The conception of the planning instrument that emerges from both analyzed cases is radically different from the one understood in urban planning.

On a positive note, although Civil Protection operators tend to view the plan solely from a strategic standpoint, and administrators often neglect spatial issues

due to convenience or necessity, the community has actively brought these concerns to the forefront. This is likely because the procedural aspects of Civil Protection may not have been easily understandable to them, while the territorial and spatial dimensions of the plan are part of their environment - elements they recognize and feel empowered to influence. In both cases, the outcomes of the process illustrate that spatial issues - such as the location of public spaces, the definition of safe routes, and the management of strategic areas - can serve as fertile ground for fostering dialogue among the parties.

Based on these considerations, the research outlines some guiding development areas that could contribute to establishing a unified framework for integrating emergency and spatial planning.

First proposes an operational tool that, by adding depth to the disaster cycle model, could help systematize the connections between stakeholders, information, actions, timelines, and data. The DRR relational database tries to explicit the complex processes observed in the form of entities and relations. This would make it possible to identify when continuity in the disaster cycle is disrupted and how communication across different phases could be better coordinated.

However, the database inevitably carries with it all the limitations of the tool, and therefore needs to be complemented by concrete actions involving the stakeholders responsible for risk reduction in the various phases.

Building on the considerations outlined so far, the research proposes a transition from the Civil Protection plan to a Strategic Civil Protection program, a programmatic tool, container of complementary instruments that include both non-spatial (operational) and spatial components.

The study's contributions are dual. First, through the systematization provided by the DRR relational database and the suggested Civil Protection strategic programme, the work aims to offer an agile tool for understanding the relationships among the different actions, tools, and actors involved in the emergency-related phases of the disaster cycle, facilitating risk reduction interventions. Second, the work seeks to initiate a theoretical reflection on Civil Protection emergency planning, a topic rich in operational and technical studies but lacking in-depth reflection on the nature of its instruments and practices. The integration of Disaster Risk Reduction into spatial planning requires a nuanced understanding of both the procedural and strategic dimensions of planning, necessitating a holistic approach that bridges the gap between emergency management, emergency planning and spatial planning.

Limitation of the study and future development

The fieldwork has played a significant role in the development of the study, both for what concern the study trajectory, and the critical categories outlined in the theoretical framework.

One of the challenges that most impacted the course of the research was the decision to use an ongoing case study, specifically the participatory planning process in Bagnara Calabra. This choice introduced complications as the research timeline

became heavily dependent on external factors, particularly the organizational activities managed by *Fondazione CIMA* and the Municipality of Bagnara Calabra. A clear example of this challenge was the inability to reach the completion of the Civil Protection plan within the research period, as the planning process extended beyond the anticipated timeframe.

However, this situation should not be seen solely as a limitation. Observing the process in real-time provided a unique opportunity to witness its entirety, adhering to the actual timelines and dynamics involved. It highlighted the significance of flexibility and adaptability in research, particularly when dealing with dynamic and evolving processes. By aligning the research with the actual progression of the case study, valuable insights were gained into the practical challenges and delays that can arise in participatory planning. These insights are crucial for developing a more realistic and nuanced understanding of the factors that influence the effectiveness of disaster risk reduction strategies.

Furthermore, the extended timeline facilitated a more detailed analysis of stakeholder interactions, the transfer of risk knowledge, and the real-time adaptation of plans and actions. It underscored the importance of coordination and communication among various stakeholders, revealing how delays and adjustments are managed and how these impact the overall planning process. This experience emphasized the necessity of considering temporal aspects in disaster risk reduction research, as the timing and sequencing of actions play a pivotal role in the success of planning and implementation efforts.

Despite the logistical challenges, the real-time observation of the participatory planning process enriched the research, providing a robust and grounded perspective that theoretical or retrospective analyses might lack.

The decision to follow an ongoing case study has also influenced the themes analyzed, particularly regarding the centrality of the Civil Protection plan within the process. The technical focus on the plan during the participation process has been rather marginal, overshadowed by other topics, for all the reasons that have been extensively explained throughout the research. This specific point could serve as a starting point for potential development in this work. Indeed, concentrating on issues more closely related to the planning components of the Civil Protection plan could yield interesting insights on specific territorial matters, which have been addressed in a more general framework in this study.

Partially linked to the timing issue, there is also the matter of observing the new regulatory innovations introduced with the new Civil Protection Code and Plans Directive. The commencement of the fieldwork practically coincided with the publication of the Plans Directive, while the *Catalogo Piani* was even published afterward. Analyzing the development of these innovations over time could represent another possible avenue for the advancement of this research.

Finally, another potential area of analysis could pertain to the proposed instrument, the Civil Protection Strategic Programs. The topic of strategic programs and complex programs is highly relevant in urban planning discourse and integrates with the concepts of urban regeneration. Understanding the role that emergency planning can play in this context represents a potentially interesting development.

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Civil Protection Department - IT- Alert
https://www.it-alert.it/it/

Labsus – Laboratorio di sussidiarietà
https://www.labsus.org/about-us/

INSPIRE Geoportal
https://inspire-geoportal.ec.europa.eu/srv/eng/catalog.search#/home

Civil Protection Department (n.d.) OSS – Osservatorio Sismico delle Strutture
https://rischi.protezionecivile.gov.it/en/seismic/activities/emergency-plan
ning-and-damage-scenarios/oss-seismic-observatory-structures/

Civil Protection Department (n.d.) RAN – Rete Accelerometrica Nazionale
https://ran.protezionecivile.it/IT/index.php

SIAM - Tsunami Map Viewer
https://sgi2.isprambiente.it/tsunamimap/

UNDRR - United Nation Office for Disaster Risk Reduction
https://www.undrr.org

UNDRR – United Nation Office for Disaster Risk Reduction (n.d.)
The DRR glossary
https://www.undrr.org/drr-glossary/terminology

Annex I

Relational Database for Data Analysis

According to Date (p.6; 2008), a database system is

"Basically, a computerized record-keeping system; in other words, it is a computerized system whose overall purpose is to store information and to allow users to retrieve and update information on demand. The information in question can be anything that is of significance to the individual or organization concerned – anything, in other words, that is needed to assist in the general process of running the business of that individual organization".

Conceptually, a database serves as an abstract reproduction of elements existing in the real world. An object that can store data, show relations and process information. Technically, a database is characterized as one or multiple structured collections of data, administered and stored cohesively, typically linked with a software (Database Management Systems - DBMS) for data updating and querying (Butler, 2015).

Many are the advantages in the use of a database systems for data storing and analysis. First of all, data can be easily shared, not only by existing applications, but also by new application that can be developed based on these same data. Then, redundancy in stored data can be reduced, saving storage space and optimizing the data collection. Last, standards can be enforced, ensuring the data contained in the system follow certain rules, that foster the simplicity of data sharing and processing (Date, 2004; p.18).

Various types of database models exist, with the most diffused being the relational database model, which is based on relational algebra. This type of database organizes data into tables, consisting of rows and columns. The key components of the relational database model include (Butler, 2015):

1. *Table:* fundamental data organization unit in the relational model. The table is a two-dimensional representation of data. Each row of the table represents a record or a tuple, while each columns represent a specific attribute or field.
2. *Row (Tuple):* A single record or data point in a table, corresponding to a unique entry. Each row contains values for each attribute defined in the table.
3. *Column (Attribute):* Represent a specific property or characteristic shared by all entities in a table. Columns define the structure of data that can be stored in a table.
4. *Primary key:* A unique identifier for each record in a table. It ensures that each row can be uniquely identified and serves as a reference for establishing relationships between tables.
5. *Foreign Key:* A column or a set of columns in one table that refers to the primary key in another one. Foreign keys establish relationships, linking related data across different tables.
6. *Relationship:* The connections between tables based on common

data elements, typically established through primary and foreign key relationships. These relationships help maintain data integrity and enable efficient data retrieval.

7. *Normalization:* The process of organizing data in a way that minimizes redundancy and dependency. Normalization helps in reducing data anomalies and improving the overall efficiency of the database.

The ability to represent and manage relationship between table is one of the big advancements offered by relational database. The relationships are often described in terms of the number of rows that can exist at each end, and this is known as the multiplicity of the relationship. Combining the multiplicities from both ends results in the relationship's cardinality.

Multiplicity is categorized as one or many, leading to different cardinality possibilities. The common cardinality configurations include one-to-one (1:1), one-to-many (1:m), and many-to-many (m:n).

In a one-to-one association, each row in one table is related to one and only one row in the other table. The most prevalent scenario is the one-to-many cardinality, where one row in the originating table corresponds to multiple rows in the destination table. The last and most complex is the many-to-many cardinality, that cannot be accommodated simply by using a foreign key. Instead, there is the need to introduce an associative table, containing the primary keys of both related tables (Figure 2).

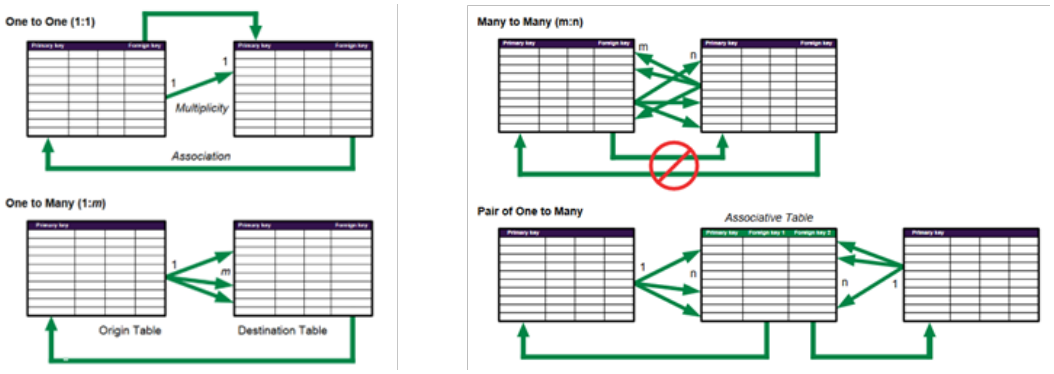

Figure 37. Database cardinality
Source: Author's elaboration based on Butler 2015.

Naming relationship can play a crucial role in eliminating ambiguity, since clear and descriptive relationship names contribute to better understanding and management of the database structure.

The language designed for manipulating and retrieving data within relational database management systems is the Structured Query Language (SQL). Since 1986, it has evolved into a standard, established by ISO/IEC 9075. However, it's worth noting that each database management system typically has its unique implementation.

A database design is normally expressed through a data model, which is a graphical way of describing the structure of a database. It is essentially a set of construction plans for a database. Data modelling is central to application development and many methodologies have been experimented along the years in order to look for efficiency (Butler, 2015).

Among these methods, the agile methodology appears to be particularly suitable for the present research, as it uses an iterative and people-centric approach, to guarantee a design and development process marked by enhanced communication and flexibility. This approach concentrates on step-by-step objectives and deliveries, making it easily adaptable. According to Butler (2015), six are the main steps that characterize the agile methodology:

1. *Define the user requirements* – define the purpose of the data and the applications requirements to be supported;
2. *Develop a conceptual data model* – identify the basic elements and relationships between elements of the database. While an entity might ultimately be reflected as a class, it's important to note that, at this point of the process, establishing a one-to-one equivalency between entities and classes is not feasible;
3. *Develop a logical data model* – specify attributes and eventually redefine elements and relationships, independently from the implementation platform;
4. *Develop a physical data model* - define the structures of single tables, domains values, data types and implicit and explicit relationships. At this point of the process, the implementation platform is relevant for the definition of the database;
5. *Test the data model* – test of the functionality and the requirements of the database;
6. *Production implementation* – creation of a default version and loading of the data.

Conceptual modelling is the first of the three phases of increasing specificity in data modelling. The main focus of this stage involves the identification of entities for which data retention is necessary and the exploration of relationships existing

among these entities. The elements to be included in the database need to be defined in unambiguous form, central concepts need to be expressed and data structures to be illustrated.

Logical data modelling extends and details the components outlined in the conceptual data model, employing abstract classes to highlight inheritance relationships among elements. This involves the addition of attributes to elements, elucidating pertinent attributes that facilitate relationships between elements. Additionally, enumerations—comprising lists of potential values for specific attributes—are incorporated into the model.

The physical data model is the most complete version of the database: classes are precisely specified, as well as their attribute. Domain classes might be included, in order to regulate data entry by restricting available choices to a predefined set.

Annex II

Fieldwork's material

- Synthetic framework of the interviews conducted
- Stakeholders list
- Meetings list and description

ANNEX 2 | **Synthetic framework of the interviews conducted**

Activity	n°	Respondent's affiliation	Topics addressed
EXE SIsma dello Stretto	10	Civil Protection Department Regional Civil Protection (Calabria) CIMA Foundation	Exercise procedure Exercise preparation Implementation of the lesson learned Technologies tested Stakeholder's competence CP planning
Participatory project in Bagnara Calabra	7	Civil Protection Department Regional Civil Protection (Calabria) Bagnara Calabra administration Technical practitioners Members of the associations taking part in the participatory process	Consideration on the development of the process Role in the project Expectation Competence and responsability Timeline CP planning in relation with ordinary planning Long term implementation of the innovation introduced
—-	2	Nucleo Emergenza Commissione Protezione civile OAR (Ordine degli Architetti di Roma)	Nature of the organization and competence Relationship with the Civil Protection Department CP planning in relation with ordinary planning

Table 7. Synthetic framework of the interviews conducted
Source: Author's elaboration

ANNEX 2 | **Stakeholders list**

DPC	Dipartimento di Protezione Civile (Civil Protection Department)
RCP	Protezione Civile Regionale (Regional Civil Protection)
CIMA	Fondazione Cima
AaP	Abili a Proteggere
LABSUS	Labsus, Laboratorio per la sussidiarietà
BC Adm	Bagnara Calabra administrators (The group typically consisted of the mayor, the councilor responsible for civil protection, and the head of the municipality's technical office)
CC	Competence Centre (INGV and ISPRA)
SS	Social Services
RC	Bagnara Calabra Red Cross Association
CA	Community Associations which signed the Collaboration Pact: • ***Cittadinanza Attiva Pellegrina*** (Association for the promotion of culture and local heritage) • ***Associazione Nella Mia Città*** (Association for the promotion of culture and local heritage) • ***Associaziona Alba di Ceramida*** (Association for the promotion of culture and local heritage) • ***Azione Cattolica Italiana*** (Religious association)

ANNEX 2 | **Meetings list and description** (Table 8 - next page)

Meetings highlighted in grey are part of the *EXE Sisma dello Stretto* exercise.

Meetings highlighted in pink took place after the drafting and submission of the first version of the thesis. I am personally still involved in the project; therefore, they have been included in the table. Some of the considerations and results that emerged from these later meetings are nonetheless relevant and should be regarded as valuable for the research outcomes.

Date	Location	Participants	Main topic/issues
29.09.2022	online	DPC, RCP, CIMA	Preliminary meeting in preparation of the EXE Sisma dello Stretto
27.09.2022	online	DPC, CIMA, AaP	Preliminary meeting in preparation of the EXE Sisma dello Stretto
04.10.2022	town hall	CIMA , AaP, BC adm	**First meeting in Bagnara Calabra in preparation for the exercise.** The emergency plan (recently approved) is presented to Fondazione CIMA.
19.10.2022	online	DPC, RCP, CIMA, BC adm	Preparatory meeting for the introductory meeting with the association and stakeholders of Bagnara Calabra who will take part in the participatory process
25.10.2022	town hall - association's space	DPC, RCP, CC, CIMA, BC adm, CA	introductory meeting - Fondazione CIMA presented itself and the programme.Two different meetings: the first one in the morning just with the administration and the second one in the afternoon with the different associations. First training meeting - INGV scientists explained tsunami and sesimic risk
04.11.2022	various		**EXE SISMA DELLO STRETTO - Bagnara Calabra**
05.11.2022	DICOMAC		**EXE SISMA DELLO STRETTO - DICOMAC**
06.11.2022	DICOMAC		**EXE SISMA DELLO STRETTO - DICOMAC**
12.12.2022	various	DPC (online), CIMA, BC Administration, CA	Debriefing of the EXE - preparation of the participatory process. First meeting with the population of the different districts
16.03.2023	online	DPC, CIMA	Update on the Bagnara Calabra project
22.05.2023	online	DPC, RPC, CIMA, BC Administration	organization of the training days - Introduction of the topic of the **Collaboration Pacts**
21-22.06.2023	town hall	CIMA, CC, BC adm, LABSUS	Training meeting - very low presence
27.07.2023	online	CIMA, BC adm, AaP	Programmatory meeting
12.09.2023	online	CIMA, BC adm, RCP, AaP, LABSUS	Programmatory meeting

21.09.2023	online	DPC , RCP, CIMA, BC adm	Training meeting - Civil Protection procedures and revision of the plan
02.10.2023	online	DPC , RCP, CIMA, BC adm, AaP	Training meeting - Civil Protection procedures and revision of the plan
24.10.2023	Town hall	RCP, CIMA, BC adm,	TTX Exercise with Bagnara Calabra administrators and other components of the local Civil Protection service
7.11.2023	Town hall	CIMA, BC adm, CA, LABSUS	Focus group for the definition of the objective of the Collaboration Pact
29.11.2023	Town hall	CIMA, BC adm, CA, LABSUS	Focus group for the definition of the objective of the Collaboration Pact - Start of the revision of the plan
15.12.2023	online	CIMA, BC adm, CA, LABSUS	Focus group for the definition of the objective of the Collaboration Pact - revision of the plan
05.02.2024	Town hall	CIMA, BC adm, CA, LABSUS	Formalization of the Collaboration Pact
22.02.2024	Town hall	CIMA, BC adm, CA	Focus group on the objective of the Collaboration Pact - revision on the plan
13.03.2024	Town hall	DPC, RCP, CIMA BC adm, CA	Discussion on the methodology for the mapping of vulnerable people
26.03.2024	online	CIMA, BC adm, CA	Discussion on the methodology for the mapping of vulnerable people
09.04.2024	online	DPC ,CIMA, AaP	Updating on the project and possible support of Abili a Proteggere
31.05.2024	online	CIMA, BC adm	Update on the project
07.06.2024	online	CIMA, BC adm, CA	Meeting with the technicians of Fondazione CIMA to discuss some doubts of the associations in relation to the plan
10.06.2024	Town Hall	RCP, CIMA, BC adm, CA	Focus group on risk communication strategies and criticalities of the strategic areas of the EP
11.06.2024	Marinella	RCP, CIMA, BC adm, CA	Site visit and participatory walk in Marinella District