

The use of serious games in engaging stakeholders for disaster risk reduction, management and climate change adaptation information elicitation

K. Fleming^{a,*}, J. Abad^b, L. Booth^c, L. Schueller^d, A. Bails^e, A. Scolobig^f, B. Petrovic^{a,g}, G. Zuccaro^h, M.F. Leone^h

^a Helmholtz Centre Potsdam GFZ German Research Centre for Geosciences, Potsdam, Germany

^b Bureau de Géologiques et Minières, Lesquin, France

^c Dept of Environmental Systems Science, ETH Zurich, Switzerland

^d Deutsches Komitee Katastrophenvorsorge, Bonn, Germany

^e Bureau de Géologiques et Minières, Orleans, France

^f University of Geneva, Geneva, Switzerland

^g OGS Istituto Nazionale di Oceanografia e di Geofisica Sperimentale, Trieste, Italy

^h University of Naples Federico II, Naples, Italy

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ABSTRACT

Disaster Risk Reduction (DRR), Disaster Risk Management (DRM), and Climate Change Adaptation (CCA) involve a variety of stakeholders with different backgrounds, organizational frameworks, divergent concerns, and sometimes competing agendas. This requires forums where such groups can meet in order to enhance understanding, reconcile different views, and potentially assist each other in meeting their respective goals. One means of establishing such an exchange involves *serious games*. During the ESPRESSO (Enhancing Synergies for disaster Prevention in the European Union) project, three such games, referred to as RAMSETE (Risk Assessment Model Simulation for Emergency Training Exercise), were developed. They were based on table-top, role-playing, scenario-based exercises, and their purpose was for stakeholder information elicitation about policy issues related to DRR, DRM, and CCA.

Participants in the exercises were assigned roles where they interacted and negotiated in order to deal with the presented scenarios. The scenarios were primarily concerned with selecting an optimal set of policies to deal with the issue in question. The games, while sometimes including an operational element, were meant to examine the motivations behind the decisions made, rather than to test or to train in response protocols. The participants in general found the games to be useful for framing discussions about complex issues, while their problem-solving character was appreciated and enjoyed. Such games allow stakeholders to openly discuss and challenge ideas, policies, and processes in a manner they would not normally do in their daily activities, with other professionals who they would not necessarily be in frequent contact with.

1. Introduction

Disaster Risk Reduction (DRR), Disaster Risk Management (DRM), and Climate Change Adaptation (CCA) involve a wide range of expertise and stakeholders. These groups in turn are themselves made up of various parties, such as civil protection authorities, natural and social scientists, urban planners, economists, non-government bodies (NGOs),

infrastructure operators, the insurance industry, and ultimately, the wider population and local communities. Furthermore, the networks that span CCA, DRM and DRR extensively overlap, while varying in terms of the government levels involved and their professional remit.

Frequently, situations arise where those involved in each sector carry out their activities within very different organizational frameworks, leading to situations where there is little contact with other concerned

* Corresponding author. Section 2.6 "Seismic Hazard and Risk Dynamics, Helmholtz Centre Potsdam GFZ German Research Centre for Geosciences, Helmholtzstrasse 7, D-14467, Potsdam, Germany.

E-mail addresses: kevin@gfz-potsdam.de (K. Fleming), zuccaro@unina.it (G. Zuccaro), mattia.leone@unina.it (M.F. Leone).

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parties (e.g. Ref. [1,2]). For example, in Europe it is frequently the case that CCA and DRR are under completely different ministries, as in Germany, where CCA is generally the responsibility of the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, while DRR falls under the Federal Ministry of the Interior, Building and Community [3]. This is an example of a situation where if so-called *silo-thinking* arose, it would hinder the proper response to situations of a common interest to both sectors, for example, the trend of increasing losses from extreme meteorological events (e.g. Ref. [4]). Similarly, in Europe the incidence of transboundary natural disasters, especially river floods and storms, sees the need for the effective management of such crises, although there are cases where the required agreements between governments are not optimal (e.g. Ref. [5]). Likewise, as Gaillard and Mercer [2] comment, part of the difficulty of integrating DRR knowledge, actions and stakeholders arises because of “the lack of trust that prevails between stakeholders”. An example of this is how governments and scientists may be dismissive of the possible contributions of local communities, while the communities and NGOs may be suspicious of the motivation of scientists and governments.

It should therefore be apparent that those involved in the sectors mentioned above must have at least some appreciation of the goals, needs, strategies, and perspectives of the other groups (e.g. Ref. [6]). Part of this requires understanding how policies are formulated, decisions made, and priorities identified [7]. This further prompts a need to understand how each sector has different expectations and understanding of how to deal with the other groups. Highlighting the quality of inter-sectoral relationships and prompting self-reflection amongst stakeholders offers a means of encouraging mutually beneficial solutions to be found when any discussion may start from a position of conflict (e.g. Ref. [8]).

One format through which different parties can meet and interact is by the use of so-called *serious games*, based on scenario training exercises. A serious game has as its primary aim something other than entertainment, which is generally education or training, although an entertainment element is still frequently retained (e.g. Refs. [9–11]). Serious games can therefore be used to frame discussions on complex and sensitive issues in an inclusive and non-threatening manner (e.g. Refs. [1,12]). For example, a review of 45 DRM-related serious games by Solinska-Nowak et al. [13] revealed that such simulations offer a rich social experience for players, allowing a diverse range of target groups to be reached while contributing to raising awareness, with each participant bringing their own experience and expertise, and allowing the identification of the value of preventive actions, triggering empathy, and the viewing of issues from different perspectives (e.g. Ref. [12]).

Considering the concept of scenarios, these are described by Durance and Godet [14] as a means whereby the presented actions can be examined with respect to possible or desired futures. Likewise, a scenario may be said to represent a possible, although not necessarily likely, series of events within a given context [15]. Scenario exercises in turn may be divided into *scenario planning* and *scenario building* [16]. Scenario planning refers to the process of proposing possible future situations, and using these situations for learning, re-examining thought processes, and testing decisions. Bradfield et al. [17] comment on the many uses of scenario planning, of which crisis management, scientific communication, and public policy development are most relevant to this paper. Scenario building, on the other hand, is the process of developing the story that will form the background to the exercise. Scenario building requires these stories to be suitably realistic, engaging, and flexible enough to allow participants to investigate the issues being considered as freely and openly as possible, although with sufficient constraints so that the issues of interest remain the key focus. Another term discussed in the literature and one relevant to this work is *scenario-based training*, which is a method that allows participants to interact with a *potential reality* in order to examine possible solutions or optional outcomes to the issues or problems presented [18].

The exercises presented in this work incorporate aspects of all these

terms. The intention was to understand and record the motivations behind any solutions proposed or decisions made by the participating stakeholders when faced with a problem or situation, which was to be solved within a policy framework the participants themselves implemented. By policy framework, it is meant the scope and limitations upon which preparations prior to and in response to a crisis are formulated, as well as how the consequences of such events are dealt with. Therefore, the exercises discussed in this paper deal with information elicitation, rather than being used to test procedures, or to gain some idea of what the future conditions may be.

As outlined by Laws and Mcleod [19], the value of scenarios is not that they accurately describe future events or situations, but that they allow those using such techniques to learn how to adapt when changes arise. This in turn would hopefully see them questioning and adapting their own frameworks, whilst being open to those of other interested groups. Within the serious games presented, it is the interactions between the participants which form the critical aspect of the information elicitation process. This is for two reasons. First, these interactions will help identify gaps, hindrances and other negative or positive aspects of the issue being investigated. Second, a critical feature of such exercises is the following debriefing session (e.g. Refs. [12,20]). The exercise therefore not only sets out a specific series of tasks for the participants to tackle, it also establishes a context for later discussions that will provide more detailed information about the issues raised during the exercise itself.

The presented games have been developed within the context of the European Commission H2020 Coordination and Support Action ESPRESSO¹ (Enhancing Synergies for disaster Prevention in the European Union). The aim of ESPRESSO project was to provide recommendations about the best directions for research and policy development in DRR, DRM, and CCA in Europe. As part of this, the project centered its activities around three challenges that had been identified to be of particular concern: (1) creating a more coherent and effective approach to DRR and CCA at national and European levels, (2) bridging the gap that exists between the science and policy/legal spheres, at national and European levels, and (3) how to improve the effective management of natural disasters within cross-border regions. The approach followed by ESPRESSO involved examining these challenges within a series of *Think Tanks*, with a separate exercise developed for each challenge. During these Think Tank events, stakeholders engaged in DRM, DRR and CCA activities took part in a serious game exercise, centered on a table-top, scenario-based, role-playing exercise, where efforts were made to gain an understanding of the issues involved, and to derive ideas for solving the identified problems and barriers examined during the exercise. While each exercise was designed to pose questions that were relevant to the particular challenge, there were commonalities between them ([21, 22]).

The aim of this paper is to present the exercises themselves, referred to collectively as the *Risk Assessment Model Simulation for Emergency Training Exercise* (RAMSETE). The following section outlines some generalities of the exercises, as well as recommendations for those who wish to develop such games, or to use the RAMSETE examples. Next, each of the exercises (referred to as RAMSETE I, II and III) is briefly described. This is followed by a discussion on how the exercises were received by the participants, some of the revisions and changes recommended by them, and some general comments on possible problems that may arise when implementing such exercises, and how these exercises may be expanded. We conclude with a summary of what can be expected from exercises like these, in particular their value in bringing together stakeholders from disparate backgrounds and with whom they are unlikely to collaborate otherwise. The actual results of these exercises are detailed in other papers in this issue ([23–25]) and the interested reader is referred to these works.

¹ <http://www.espressoproject.eu/>.

2. Developing the RAMSETE series

Although serious games have been developed for purposes such as training crisis managers (e.g. Refs. [15,18]), assessing natural risk management (e.g. Refs. [26,27]), and dealing with CCA (e.g. Refs. [12]), the most important point is again that the RAMSETE series are not designed for operational training or teaching, but for information elicitation from stakeholders with regards to the three ESPRESSO challenges. In fact, it may be said that the aim of these exercises is for the players to teach those running the games. The specific purposes of each exercise in relation to these challenges and some of their details are listed in Table 1.

2.1. Commonalities

A number of common elements exist between each exercise.

- The primary interest of each exercise involves understanding the reasoning behind the players' choices with regards to policy development, policy change, and decision making. All of these will be dependent upon the participants' background, who will bring their own experiences and belief systems (e.g. Ref. [1]).
- The participants of each exercise are assigned a *role*, representing a particular sectoral interest (political, scientific, civil protection, etc.). Although considerable effort was made to ensure each participant is comfortable with their allocated role during the Think Tanks, it was not always possible to have their roles matching their professional backgrounds. However, the exercise developers (and the participants themselves) were not especially concerned, since this should be seen as an opportunity to add objectivity to the proceedings (especially considering that it is understanding the motivation behind the decisions made that is the aim, rather than presenting so-called correct answers). Note that other studies have employed the placement of participants in differing roles so that they will need to confront the issues of concern from different perspectives (e.g. Ref. [12]).
- Each exercise makes use of some form of metric, or metrics (see Table 1), which allow the participants to keep score and see how they are progressing. These metrics provide a measure of some aspect relevant to the scenario (e.g., the population's well-being) that will increase or decrease, depending upon the decisions made. In addition, a budget is introduced, which limits the actions that may be made in each round (see below), leading to the need to prioritize decisions and to negotiate with the other roles.
- A selection of materials is required for each exercise. These include a table sheet or game board to serve as both a visual reference to assist in recording the decisions and accompanying motivations during the progress of the exercise, and to keep track of the various metrics. An assortment of tokens representing the metrics is used to allow the participants to more easily keep score. It was considered important to the players that they felt they were playing well or moving forward, since competition and a will to succeed were factors that would hopefully kept players engaged.
- A series of different forms of cards are usually used for each exercise. These outline what actions or policies are permissible (action cards), the idea being that when a policy or decision is made, the appropriate card is *played*. In addition, there are cards that provide information about a disaster event or the state of the scenario (event cards), as well as those that provide role-dependent information to the participants themselves (information cards).
- The exercises are divided into a number of *rounds* representing a period of time. In all cases, the time scale is multi-year, but this may be set for a certain number of years, an unspecified period of time, or an election cycle. In any case, it is during these periods that the decisions are made. The format of the rounds themselves vary, but in general time is allocated for participants to study and discuss amongst themselves the available options, to implement the

Table 1

Some details of the three ESPRESSO exercises. The dates and locations below the exercise names are where the ESPRESSO project Think Tank meetings were held during which the exercises were conducted.

	RAMSETE I October 2017, Berlin, Germany	RAMSETE II January 2018, Zurich, Switzerland	RAMSETE III April 2018, Naples, Italy
Challenge	Propose ways to create more coherent national and European strategies that treat DRR and CCA in an integrated manner.	Address issues surrounding the effective management of cross-border crises, considering the local, national, and international levels.	Improving DRM capacity by identifying and developing frameworks for bridging gaps between the scientific and legal/policy spheres with regards to DRM and CCA at the local, national and international levels.
Scenario geographical backdrop	The fictional 'European' island state of <i>Espressoland</i> .	The fictional 'European' cross-border region of <i>Barristia</i> , located between <i>Macchianstein</i> and <i>Latteia</i> .	The fictional 'European' island state of <i>Espressoland</i> .
Number and roles of the games' participants	5 – Scientific researchers in DRR and CCA, ministries of the Interior and Environment, and local government.	6 – Central and local government representatives for each country, NGO and European Union representatives.	4 – Decision maker (political leader), science advisor, civil protection, government spokesperson.
General scenario narrative	Maximize the security and well-being of the population of <i>Espressoland</i> by integrating DRR and CCA policies.	Implement the optimal policies to allow the various roles to respond to a cross-border crisis, and ensure the ongoing capacity of the region's towns, cities, and infrastructure.	Maximize <i>Espressoland's</i> capacity to respond to an impending disaster under conditions of scientific uncertainty in the most effective and accurate manner, while ensuring the popularity of the government.
Metrics	<u>Shields</u> : representing the DRR capacity of the island. <u>Leaves</u> : representing the CCA resilience of the island. <u>Handshakes</u> : reflecting the social cohesion of the island's society. <u>Beans</u> : the currency of <i>Espressoland</i> .	<u>Production capacity</u> of the cities and towns. It also represents the vulnerability of these locations, and the impact of any event. <u>Beans</u> : the resources made available for various actions.	<u>Trees</u> : reflect the forecasting capacity of the island. <u>Shields</u> : evacuation capacity of the island. <u>Medals</u> : representing the population's trust in the institutions. <u>Beans</u> : the currency of <i>Espressoland</i> .

decisions (which may involve re-defining a policy, responding to an event, etc.), assessing the consequences, then discussing again their motivations.

- The geographical areas that form the background to the scenarios are fictitious, yet realistic European countries. While in the early stages of RAMSETE's design actual past events were considered, it was soon realized that given that the participants were from across and beyond Europe, it would be unreasonable to expect them to have sufficient knowledge of any one selected country's DRM, DRR, and CCA

situations. Hence, the policies and frameworks assumed for each scenario were a mixture of real-life European examples worked into a fictional setting.

- In addition to the participants, each exercise has a facilitator and a recorder. As the names suggest, the facilitator’s role is to ensure the smooth running of the exercise, i.e., explaining the rules, disseminating material as the exercise progressed, sorting out any unexpected problems (e.g., the participants may propose a course of action not considered by the game developers, hence requiring a quick decision to be made concerning its validity), while also ensuring that the exercises progressed in a timely fashion. The recorder notes down the decisions made and the relevant points emerging from the discussions between the participants. Such discussion points could include informal comments regarding any issue with which the exercise was concerned, including how the exercise itself may be improved upon.

2.2. General guidelines

Fig. 1 outlines the general process followed when developing and executing RAMSETE exercises and assessing the outcomes. The general scheme for designing the games is referred to as MDA – Mechanics, Dynamics and Aesthetics (e.g. Refs. [28,29]), which breaks down the game’s development into the mechanics (components of the exercise, rules governing the permissible actions and responses), dynamics (the behavior of the players in terms of their input and the resulting output), and aesthetics (the sort after emotional response of the players). Such a process allows the design of the game to be considered from the perspective of the designer and the player simultaneously [29]. The following guidelines are kept as general as possible, with the aim of allowing any designed exercise to be as comprehensive and useful as possible.

2.2.1. Development of the exercise

What overarching issues are being dealt with? This is obviously the first aspect of the exercise that must be considered as it will affect all components of the game. The resulting serious game would need to reflect a selection of conflicts, compromises, barriers and synergies that would be apparent (or assumed). Naturally, all relevant issues cannot be

explored, and those that are will need to be reduced to a few basic conflicts that allow a (relatively) simple set of rules to be developed when considering the game mechanics and logistics.

What roles are involved? The roles may be considered to be personified stakeholders. For example, if the scenario deals with a transboundary crisis, then not only national, but also international actors must be represented. Since these exercises are concerned with policy development, stakeholders from different sectors and disciplinary backgrounds will need to be represented.

The number of participants should be kept relatively low (for RAMSETE, this was between 4 and 6), in order to keep the exercise mechanics as simple as possible, to allow free-flowing discussions, and to ensure the more efficient recording of the game’s progress.

What actions will be considered? The first question here is whether the scenario employed in the exercise follows an operational-like narrative, or will it be more focused on policy development. By operational, we refer to the situation where the players must deal with a disaster and an effective response needs to be made. For policy development, this means an emphasis on negotiation and the identification and comparison of different policy-technical options, within the context in which the scenario is set. The actions themselves will also depend on the selection of roles, with the actions divided between those associated with, e.g., political leadership, research and development, infrastructure establishment, education, welfare, etc. Furthermore, a combination of the two may be considered.

What events will be considered? The considered events, of course, depend on the issues being examined. For example, if CCA is the main topic of concern, then (hydro-) meteorological or climatological hazards (e.g., storms, heatwaves, wildfires, and droughts) will be the focus. However, as these are more policy-driven games, specific events need not be described in great detail. In any case, the defined events must be realistic and appropriate for the setting used. What must be kept in mind is that any developed scenario is pertinent, coherent, likely, important, and transparent [14].

How is the scenario area defined? RAMSETE makes use of invented geographical regions so as not to put at a disadvantage any of the participants who may not be familiar with any considered real-life area. The imagined area needs to be consistent with the questions being asked. For example, if cross-border issues are the concern, then the

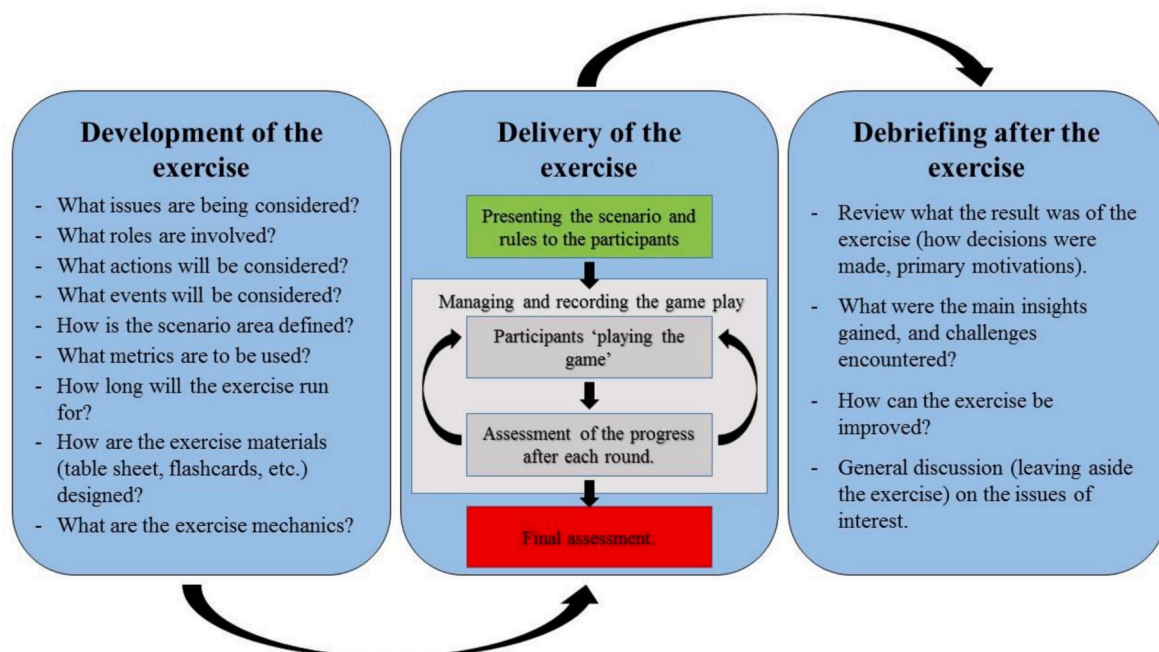


Fig. 1. The general process and considerations for developing, executing, and then assessing the RAMSETE exercises (modified from Moats et al. [18]).

geographical area designed for the game needs to involve a trans-boundary region. Likewise, if considering CCA, then the defined region would need to involve more weather- and climate-related processes, events, and knock-on impacts.

On the other hand, this does not exclude the possibility of using real regions, provided the participants are familiar with the selected area. For example, an initial plan to investigate issues surrounding trans-boundary crises was to consider the tri-national border region between Switzerland, Germany and France. However, this was rejected for the reasons just discussed, i.e., not all participants would be familiar with these countries' policies. Nonetheless, to run a RAMSETE-type exercise covering an actual region or area that the participants had knowledge of would be advantageous for international bodies such as the Upper Rhine Conference [30]. However, it should also be remembered that depending on the region of interest, there may be more sensitive issues involved that the participants may not wish to discuss at such a meeting.

What metrics are to be used? The main reason to use metrics, or scores, is as a shorthand for measuring success (or otherwise) in a particular task (out of several) within the constraints of the game. For the participants undertaking the exercise, this acts as a point of clarity and a source of motivation. For the evaluators, the introduction of metrics allows for an easier comparison of gameplay outcomes between different groups. As can be seen in Table 1, each game had several unique metrics, signifying to the players that there were different, often competing, aspects that they needed to focus on. The nature of said metrics is a function of the issues being investigated. For example, an exercise may be undertaken where the concern was a population's well-being, the level of social coherence, or how well the roles cope with a disaster event (e.g., the restoration of damaged cities, infrastructure, etc.). The difficulty in this part of the game design process is how to evaluate the cost or benefit of each metric (i.e., the assigning of values). By their nature, metrics quantify an aspect that can often be difficult or impossible to quantify. Since this is a problem shared by multi-criteria analyses when considering intangible or qualitative aspects, the authors used the guidance provided by Annex 7 of [31]. Furthermore, the compendium of CCA actions and their associated costs in the Netherlands presented in Ref. [32] was an important resource for assessing metrics for both qualitative and quantitative aspects. This in fact takes up a considerable proportion of the game's development time, with an aspect of trial and error involved, hence requiring any exercise to be tested in practice sessions prior to the formal ones.

How long will the exercise be run for? The RAMSETE sessions currently ran for between 2 and 3 h. However, longer sessions would allow a more comprehensive and complex range of possibilities and issues to be explored, as well as providing greater flexibility in managing discussions. Regarding the number of rounds, it was found that 3 or 4 is sufficient, otherwise the exercise becomes somewhat repetitive and the participants lose focus.

Designing the exercise materials. The materials used in the exercise, from the table sheet to the various cards and tokens representing the actions and metrics, will require an element of aesthetic merit, in part simply to add interest to the session. However, whilst it is important that the material is visually engaging, it must also contribute in some way to the exercise itself. For example, a map of the scenario area on the table sheet allows participants to visualize the situation, while the table sheet should provide the participants with a visual record of the exercise's progress, as well as assisting in their decision making. Likewise, the cards covering permissible actions, event descriptions and other information should be designed with simplicity in mind, as too much information distracts the participants, while too little can lead to confusion.

How can the exercise rules (mechanics) allow the issues in question to be examined? As stated above, the issue under consideration needs to be broken down into segments that lend themselves to relatively simple and straightforward rules. While a certain amount of calculation will be inescapable, especially if a metric and limited budget

format is followed, the rules should be simple enough so that excessive time is not spent explaining them. The mechanics themselves may be divided into the following features:

- What actions are permissible and which are not (dependent upon the overarching issues being dealt with by the exercise) by which roles?
- What are the relationships between roles? For example, what rules are in place in terms of who can communicate with whom? How can resources be shared?
- How are the actual values of the metrics determined? This part will require some iteration when preliminary versions of an exercise are played (see above).
- How is the exercise within the rounds divided? While any combination of *phases* may be employed, it is important that there is some form of subdivision within each round, allowing the different stages of policy development (e.g., consideration, implementation, reconsideration) to be dealt with.

2.2.2. Delivery of the exercise

Presenting the scenario and rules to the participants. This is the obvious first action within an exercise session, but also the most important. During the ESPRESSO Think Tanks, there was always a short presentation by the RAMSETE development team about the exercise mechanics prior to the session. This information was then repeated at the start of the exercise, and reinforced as it proceeded. This was the main task of the steward/facilitator.

Managing and recording the game play. The role of the steward/facilitator is not only to ensure that the participants understand the objectives of the exercise and the rules, but also to find a balance between free-flowing discussions and the actual exercise. As emphasized, it is the interactions between roles that allows the issues being investigated to be understood. Therefore, although the discussion may briefly deviate from the main topic, this is of little concern as the participants are there to pass on their own personal expertise. However, a balance is needed to allow the whole exercise to be undertaken, which itself allows the different topics to be explored in the allotted time. The importance of the recorder is therefore to ensure all of the main points, not just of the game play, but other discussions related to the issues of concern, are recorded.

Participants playing the game and assessing their progress after each round. One of the advantages of following a round system is that it includes opportunities to assess how the participants are proceeding. During the time when the participants are engaged in the exercise, the steward/facilitator and recorder should try to avoid contributing to the discussions – the aim is to listen to them – unless of course it involves explaining some rules or element of the process. Such ongoing assessment is also an opportunity for the recorder to note down as much information as possible, to collect opinions about the exercise itself, while at the same time allowing participants to potentially reassess their strategies.

Final assessment. This part of the exercise is where the motivation behind the decisions is more fully described, as well as providing an opportunity to reflect on and discuss what alternative schemes might have been chosen and why. This would also allow a group report to be prepared (see below).

2.2.3. Debriefing after the exercise

A period dedicated to debriefing is possibly the most important part of the whole procedure. Crookall [20] in fact describes the debriefing session as needing to be considered from the beginning of the game's design, while Rumore et al. [12] describe it as when the participants can reflect on the experience and relate it to reality. The main points that such a debriefing would cover are:

- If more than one group are involved (as was the case in the ESPRESSO Think Tanks), then each group should have the opportunity to

present the outcomes and general impressions of their exercise session to the collective audience. This should outline the final outcomes (e.g., what the metric score was, was a certain required task achieved, etc.), as well as suggesting how to improve upon the exercise.

- During the course of the debriefing, the main insights into the topics of concern must be discussed and summarized. This is in fact the whole reason behind the undertaking of such exercises and will form the basis for subsequent efforts to deal with the concerns of the participants that are linked to the themes of the exercises.
- The participants need to be asked for their suggestions as to how to improve the exercises, both those who may have experience with such activities, as well as those for whom gaming is new. These contributions would be expected to range from suggesting what roles should be considered, how actions can be revised or expanded, how the mechanics of the exercise may be adjusted, to more simplistic matters such as how to style and produce the required material.
- The debriefing will also include a general discussion, where other topics related to the issues of interest are covered. This may in turn call upon other group exercises to encourage active interactions and the presentation of different views and ideas.

3. The RAMSETE series

3.1. RAMSETE I – creating coherent national and european approaches that integrate DRR and CCA

The first challenge [23] was concerned with how there is often a lack of interaction between DRR and CCA, despite the obvious overlap between them (e.g. Refs. [33–35]). An example of the sort of issue investigated is the *silos effect*, which manifests itself by a lack of information flowing between separate groups, for example, between different levels of government, agencies, or parts of an organization (e.g. Ref. [36]). This would be the case if there is little contact between civil protection authorities and those working in CCA policy, as discussed in the introduction. The concern therefore is that DRR and CCA parties may not fully comprehend the needs and goals of the other, while there may be conflicting agendas and competition for resources and attention from the political and community leadership (e.g. Ref. [1]).

The scenario exercise employed during the Think Tank dealing with

this challenge (see Table 1) was concerned with the participants increasing the well-being and security of the fictional European island state of Espressoland. Espressoland is exposed to a range of natural hazards (volcanic eruptions, earthquakes, landslides, floods, storms, etc.), where the prospect of meteorological-related hazards, such as storms, droughts and floods, increasing in intensity and frequency due to climate change needs to be considered. Therefore, the exercise was designed so that the participants must collaborate with each other to develop strategies for DRR and CCA that will increase the population’s resilience to the negative effects of extreme events.

The exercise involved five roles: the Environmental Ministry (concerned with CCA, MIN ENVIR), the Interior Ministry (concerned with DRR, MIN INTER), local government (concerned with both, LOC GOV), and scientific advisors for DRR (who report to the Interior Ministry, SCI DRR) and CCA (who report to the Environmental Ministry, SCI CCA). Communication barriers were purposely established so that the participants had to make a conscious decision (i.e., play specific cards) to establish communications and break down the silos. This is explained in Fig. 2, which shows how those participants involved with, say, DRR, could not communicate with CCA unless certain cards were played that allowed synergies between ministries to be developed (which included the sharing of expenses).

The general sequence of the game (see Fig. 3) first involved a review of a virtual 5-year period prior to the starting point of the exercise to outline the state of Espressoland. At this point the round begins (representing a 5-year period), starting with the distribution of role-dependent information to the science participants, general information to the group, budget to the government roles, and the appropriate action cards. Note that as cards are played, they allow higher-level actions to be carried out. The participants familiarize themselves with the action and information cards, then approximately 20 min is spent discussing which cards are to be played. There is no limit to the number of cards used, except for the available budget, although the budget will not permit all possible actions to be undertaken (hence negotiations between the different roles is critical), while some cards require synergies between roles.

For the information cards, participants may choose to expend resources to obtain more detailed information, which would help them to decide which action cards are chosen. The selected cards are then played, which then defines the scores of the various metrics (shields for

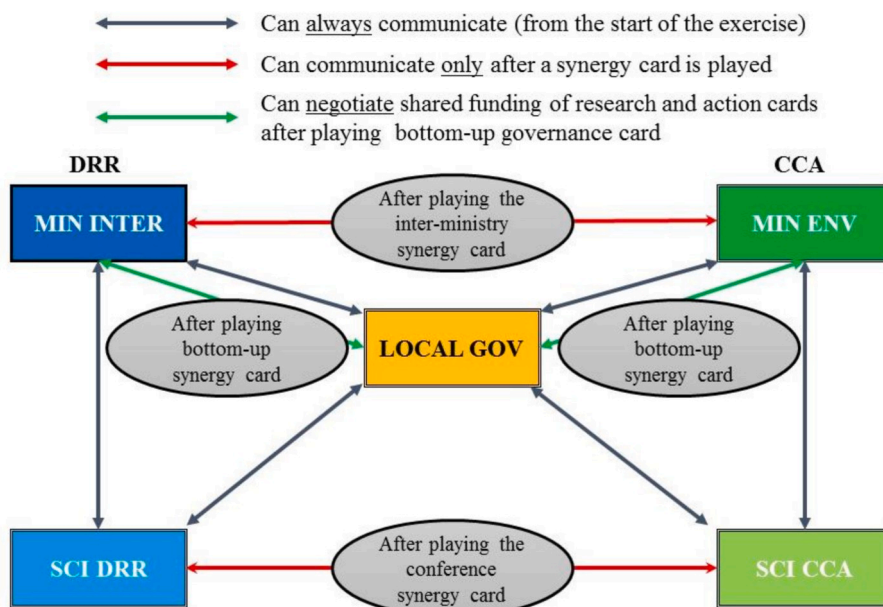


Fig. 2. The interactions between the roles in RAMSETE I, and how they change during the exercise when certain cards are played. The desired outcome is for interactions between all roles (requiring the expenditure of resources).

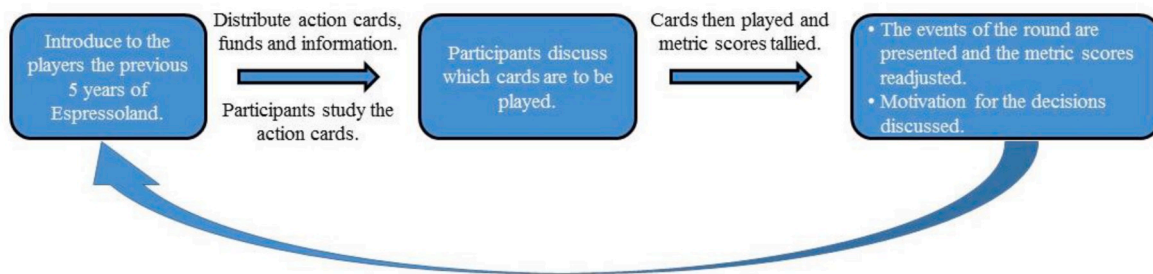


Fig. 3. General scheme of the RAMSETE I game.

the island's capacity in DRR, leaves for the island's CCA capacity, and handshakes for the social cohesion and strength of the island's society, see Table 1). The events of that round are then presented and the metrics adjusted according to the losses endured, which are dependent upon the decisions made during the round. Some time is allocated for the participants to discuss the reasoning behind their decisions, and the consequences of these actions within the context of the round's events.

3.2. RAMSETE II – addressing issues surrounding the management of cross-border crises

The second exercise [24] was concerned with issues surrounding the effective management of cross-border crises, which are becoming an increasing concern in Europe [37], especially considering that around 20% (115 million) of European citizens reside within 50 km of a national border [30]. As an example, the Danube Basin covers 19 countries, with some 81 million inhabitants.² Of particular interest were issues around how a country's legislation and DRM framework affects the actions undertaken. This involved not only the interactions between countries, but also with NGOs within a country, as well as with European supranational bodies, in particular, what role should such bodies have (e.g. Ref. [38]).

The setting for the RAMSETE II exercise was the fictitious border region of Barristia, located between two European Union states, Macchianstein and Latteia. The two countries share a common border with a high level of cross-border economic activity. The whole region is exposed to a range of natural hazards, such as earthquakes, floods, storms, as well as natech (natural technological, e.g., a chemical spill triggered by an earthquake) events. The exercise sees the participants confronted with a series of extreme events, requiring collaboration between the nation states, the NGOs, and European mechanisms. While this exercise may seem more operational than RAMSETE I, the interest is in the decisions made about what are the best policies to follow so as to deal with extreme events, while taking into consideration the other nation.

Each country was defined as initially having different civil protection organization schemes, that is the choice between a centralized (e.g., France) or decentralized (e.g., Germany) system. There were also differing regulations for requesting/offering assistance during cross-border crises, and how NGOs and the EU could contribute. In addition, there was a recovery phase, which included the option of *building-back-better*. The challenge was therefore to best combine policies so as to make the most effective use of resources in order to safeguard their own territory, and to prevent the other country's crisis affecting theirs. The process of the game (see Fig. 4) therefore saw the participants working within existing regulations, but then deciding on which ones to change where possible, which in turn involved the use of resources. However, negotiations between groups were required to ensure that this expenditure was worthwhile.

There were six participants divided into four roles. Each country has two roles, representing the central and local governments. There are also participants representing NGOs (one for both countries) and the combined European Emergency Response Capacity/European Union Solidarity Fund (EERC/EUSF). The metrics employed include a budget within which the participants must work, while the budget division between the government roles was dependent upon the policy framework followed. The other metrics represent the vulnerabilities of the assets, meaning the cities, towns, a bridge, industry, and a nuclear power station. Each country may not have the budget to fully cover their own repairs (failing to fully repair an asset will reduce its production and impact upon both countries, given the cross-border economic links), hence negotiations between countries, the NGO and EERC/EUSF are critical.

The exercise was made up of three rounds, each of around 1 h, consisting of several phases. (1) The policy and preparedness is when the participants negotiate among themselves on how to best establish national and transnational regulations for the most effective response to natural disasters. These policies cover national and transboundary issues, NGOs, the role of supra-national (European) bodies, and recovery. Only a limited number (three in the first round, two in the others) of policy changes could be made. The decisions made in this phase therefore are what would affect the participants' responses to the disasters and their aftermath. (2) The response and recovery phase, where an extreme event has occurred and the participants must deploy their resources to cope with the resulting damage to the affected assets, remembering not fully repairing something affects both countries. (3) The debriefing phase, where the participants present their motivation for the decisions made. This is therefore one of the more critical aspects of the exercise. It also allows the stakeholders to discuss the more realistic situations given such circumstances in the real world. One difference between this exercise and RAMSETE I was that cards were not used. Instead, different table sheets were employed for each round, with markers indicating the changes in policy, the type of event that occurred (extreme weather, flooding, earthquake), and spaces to note down the decisions made in terms of how resources were used and comments on the motivation behind the decisions made by each role.

3.3. RAMSETE III – dealing with uncertainty in emergency situations

The third exercise [25] dealt with challenges related to issues arising from science and policy/legal aspects of DRM, in particular, responsibility. For example, what are the consequences for civil protection authorities when they carry out evacuations based on imperfect information? Who authorizes the evacuation? This in turn is strongly related to the issue of uncertainties under which policies and decisions are usually made (e.g. Ref. [1]), which in this exercise affect any decisions over both spatial (where do we evacuate to?) and temporal (when do we evacuate?) scales. For example, tracking the potential intensity and actual movement of a storm can still not be perfectly done despite advances in the meteorological sciences, while understanding how much and in what manner a region's climate will vary hinders CCA adaption

² <https://www.icpdr.org/main/danube-basin/countries-danube-river-basin>.

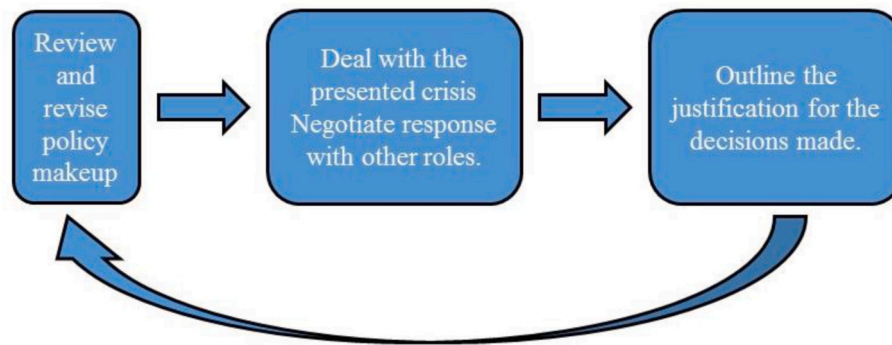


Fig. 4. General scheme of the RAMSETE II game.

planning. This then raises issues related to budget allocation, such as what resources are available to allow scientists to improve their predictions?

The scene for this exercise is again Espressoland, although this time with something of a more operational character, while the considered time scale is an election cycle. The roles involve an elected official (the decision maker) selecting the policies they believe are most appropriate based on the advice of advisors, representing the science community (concerned with the forecast uncertainty and the accuracy by which an impending disaster may be known), civil protection (how quickly an evacuation may be undertaken), and a government spokesperson (concerned with the public's approval of the government). The background to the scenario is that policies are established that balance the ability of scientists to predict the timing and location of a hazardous event, of the civil protection's ability to evacuate effectively and quickly, and for the government spokesperson to ensure the public's support of the government. The latter point is the primary metric for this scenario, as the elected official needs to retain public confidence to be re-elected.

Similarly to RAMSETE I, three metrics were employed (see Table 1): trees, reflecting the island's scientific capacity in terms of forecasting capacity (i.e., accuracy of defining the location and timing of an event), shields, which indicate the civil protection's ability to undertake effective evacuations, and medals, reflecting a government's approval, and is the final measure that decides if the decision maker is re-elected.

As with RAMSETE II, this exercise was divided into three stages (see Fig. 5). First, the policy making phase, where the decision maker chooses an overall policy framework centered on either an environmental platform (focusing on science), a technocratic platform (focusing on civil protection), or a social issues platform (focusing on public option). Based on the chosen framework, a total of seven policies (presented as cards) are then chosen, where the selected policy allows three to be selected from that focus, and two each from the others (as in RAMSETE I, the policies are described on the cards). Second is the crisis phase, where there is a time-critical event and the participants must respond in such a manner that a balance is found between the need for more information about the coming disaster, and when to order (or not) an evacuation (in this exercise, the events were storms). Evacuate too soon, and popularity is lost by the population waiting, evacuate too late (or not at all) and popularity suffers significantly. The actions (again presented as cards) involved efforts to better define when and where an event will affect the island, evacuation preparations, the evacuation itself, and press conferences (essential to maintaining the government's popularity). The actions and consequence all lead to modifying the number of medals (popularity). The final phase is the election itself. This is decided by the remaining medals: if it is above a certain threshold, the election is won, else it is lost and a new policy framework must be decided.

Although evacuations are the focus of this exercise, by no means is this meant to suggest that this would be the only or most important issue of concern. Likewise, the use of storms was for the sake of simplicity, given time constraints on the development of the exercise. Naturally,

one can easily consider other types of events, while including land-use planning would potentially permit a longer-term dimension to be added, especially if, for example, multi-hazard, cascading, or Natech events are considered.

4. Discussion

The results from each of the games were derived from the records made during each session (several separate sessions of each game were held during the Think Tanks) and are presented in the works accompanying this issue ([23–25]). The following are some more general points that are relevant for the developed serious games as a whole.

4.1. General reaction of the participants

In general, the participants found the exercises to be an interesting and fruitful way of confronting the many issues that were covered. This includes individuals who commented at the start of the exercises that they had no previous experience in serious games. It should be emphasized that the participants represented a very wide range of professions and nationalities. Aspects of the exercises that the participants particularly appreciated included the problem-solving approach, which was useful for structuring the subsequent discussions. Some participants also commented that the exercises are very useful for fostering critical thinking on current practices. Valuable ideas on how to improve the exercises, for example, how to make them more inclusive, were offered and will be discussed below.

4.2. Improving the exercises

The advice gained from the participants as to how to improve the exercises was especially valued, given the diversity of participants' backgrounds. Some comments were relatively minor, for example, how budgets could be more realistically distributed, which, while perhaps leading to unrealistic decisions, did not seriously affect the outcomes. Other suggestions involved the choice of policies that were available, their respective costs, and issues such as the maintenance of played actions involving infrastructure (which arose in RAMSETE I). The suggestions could therefore be divided between those more relevant to the specific exercise (which would vary if a different style of scenario were employed), and more general issues, which were sometimes rather serious and could significantly impact upon the exercise's design.

An example of a suggestion that provoked discussion within the design team was the case of missing roles, raised during RAMSETE I. In fact, this point requires considerable attention, as one of the aims of the exercises is to bring together stakeholders who may otherwise have few opportunities to interact, an issue raised by Gaillard and Mercer [2] when they discuss the lack of space for dialogue across what they term the hierarchy of scales (e.g., between national and local). The most prominent example was that of the media. The importance of the media

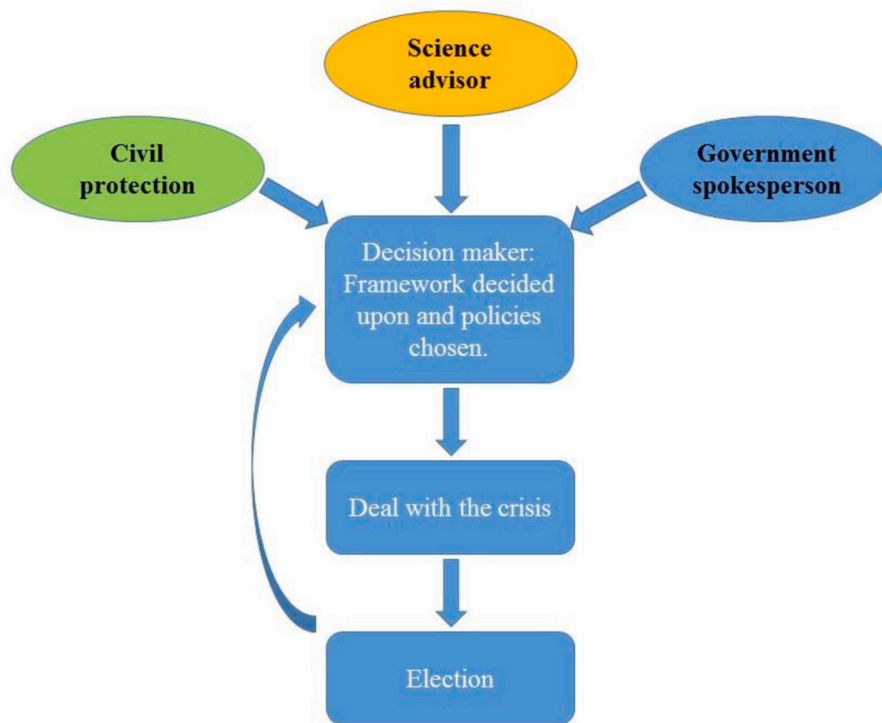


Fig. 5. General scheme of the RAMSETE III game.

as a stakeholder is fully acknowledged (e.g. Ref. [39]), and serious consideration was given to this point by the RAMSETE design team. However, owing to limitations in the availability of such experts, as well as limits to the number of participants who would be involved, it was not possible to include this role. Nonetheless, inclusion of the media is certainly an interesting prospect for future versions of RAMSETE. For example, RAMSETE III would certainly benefit from including such a role, in particular for interactions between the decision-maker and government spokesperson. Other roles that may be incorporated into future versions of RAMSETE would include a representative of civil society, or as one participant put it, a voice of the people, the insurance industry, and other more operational stakeholders, e.g., infrastructure operators, first responders, etc. Considering the latter suggestion, while an operational-type scenario could be used, the aim of these exercises is information elicitation, not the testing of procedures. However, an example where the two may coincide comes from the use of the exercise to gain a better understanding of what responders may require in terms of information (e.g. Refs. [40,41]), or if we return to the RAMSETE II cross-border exercise, what their permitted scope of activities may be.

Another suggestion was the incorporation of wild cards, where a policy could be proposed by participants themselves, raised during RAMSETE I by some participants who believed that the range of choice was too limited. The idea of such cards was that participant imagination could be more fully exploited. However, as time was limited, a more comprehensive selection of policy choices, including opportunities for new ideas, could not practically be provided.

4.3. Difficulties involved in the use of such exercises

During these exercises, some general insights into the problems in using role-playing exercises for research purposes came to light. For example, it is difficult to address precise research questions, e.g., what are the factors driving participants' decisions on disaster policy change? or to test hypotheses concerning the relationships between specific variables, e.g., does participant agreement on what actions to undertake during a crisis also lead to improvements in crisis management?

The initial idea behind these exercises was that they could be used to gain information about the challenges as a stand-alone tool, although the use of such role-play exercises came to be considered to be more like conversation starters [12]. Hence, while these exercises certainly allowed a great deal of insight to be gained on their own, the debriefing sessions which followed were where the most reflective perspectives were gained (e.g. Ref. [20]).

The following are some issues that may arise (including those based on the ESPRESSO experience) and would need to be dealt with by those employing such serious games or role playing exercises. Several of these issues do not necessarily have a simple solution, and therefore require the personal experience and discretion of the steward/facilitator, the importance of which cannot be underestimated [42].

Language barriers. This is an issue that can easily arise during such exercises within an international context. The only solution is to ensure that there is a sufficient range of language skills amongst the participants and game organizers (steward/facilitator, recorder) that a participant who may have some difficulty in the host language (which for the ESPRESSO Think Tanks was English) has someone sufficiently fluent in the host and their language to translate and report.

The exercise goes off-course too often. While, as mentioned above, it is not necessary to be all the time totally focused on the exercise, it must be kept in mind that the exercise is the reason for the meeting and that the discussions need to remain, more or less, focused on the topic at hand. It is therefore the responsibility of the steward/facilitator to ensure the discussions are focused and to approach participants when necessary to keep them on track.

Participants not participating. It may arise, for whatever personal or cultural reason, that a participant is not as active as would be ideal. For example, a participant may be uncomfortable in the role they have been assigned. Such a situation obviously needs to be dealt with delicately by the steward/facilitator, perhaps by engaging the participant with questions. Similarly, if one participant is overly zealous, then the other participants may need to be encouraged to voice their opinions so they are not overshadowed. It may also be possible that a role has been poorly defined, with, for example, little influence on the game itself.

Such a situation would need to be kept in mind during the game's development.

4.4. Future exercises

One issue that needs to be considered when designing such exercises is to keep a balance between size (number of participants, duration of the exercise) and complexity (how many factors are included, and how realistic are they). In the case of the RAMSETE, due to the small number of participants (four to six) and short time periods (two to 3 hours), few realistic details could be incorporated into the exercises' designs. Furthermore, owing to the mixture of nationalities taking part in the Think Tanks, more generalized policy frameworks were considered, although during a policy analysis conducted as part of ESPREsSO, it was found that many of the issues included in the exercises were still applicable to most European countries.

One could tailor these exercises to reflect more realistically the perspective of a specific national, or regional situation. However, this would significantly increase the complexity of the exercise, both in terms of its design and in its execution. The inclusion of other roles (e.g., media) could bring additional insights to the needs and expectations of the groups involved. However, again as the number of roles grew, so would the complexity of the exercise mechanics, including the need to balance the interactions between participants. In all these cases, it is a question of considering what could be gained from such an increase in complexity. Overall, if the exercise is too complex, it will be difficult to keep track of the game play, while if it is too simple, then the discussions may be too generic.

Another issue concerns the cultural context within which these exercises were conducted. While the discussions and interactions during these exercises were very open and rather lively at times, one could imagine a situation where a less open or more hierarchical society may not allow RAMSETE-like exercises to realize their full potential. Hence, before such exercises are exported to other settings, the cultural background of the potential participants would need to be seriously considered and treated sensitively.

Some general areas where the exercises might be improved or expanded upon include:

- A wider range of roles, while still keeping the numbers of participants low enough to ensure ease of discussion.
- How long the game is played for? This may not need to be varied, as the current exercises are designed to be played over 2–3 hours, which, when combined with the introductory sessions, debriefing and other discussions, would realistically comprise a full day's workshop. It would also not necessarily mean more rounds, as this could lead to an element of repetitiveness. However, some flexibility would be required, where, on the one hand, the play sessions could be extended if the discussions are especially fruitful, or on the other, reducing them when it appears that the topics under discussion have been exhausted.
- The period of time represented by the game. As policy was the main concern, the RAMSETE exercises considered time scales of years or election cycles. However, if longer term issues were to be investigated (e.g., if considering CCA), then the exercises could be adapted by considering longer periods. For example, during the SENSUM³ game, the exercises were divided into time periods of 1 day, 1 week,

1 month, 1 year, 2+ years following an event [40]. One could envisage a timeline established for a game where with each round, the time period covered is longer, leading to different emphasize in the policy making.

- A more comprehensive range of possible actions, as well as enforcing resource limitations. This could lead to a more complicated exercise, or one that may be undertaken covering longer time periods. The enforcement of resource limitations would also lead to a more realistic decision-making process where so-called hard choices would need to be made and priorities set. Together, such changes should allow more realistic scenarios and cases to be investigated.

The issue then is what the next steps following such an exercise and the subsequent debriefing ought to be. While individuals will at least hopefully leave with a greater appreciation of the complexity of the problems they are dealing with, as well as understanding better what issues other stakeholders face, without follow-up actions such as meetings or collaboration, the efforts that go into developing and executing these exercises would come to little value. In other words, these exercises need to be part of a wider process within an organization that is trying to better fulfil its mandate. For example, the exercise organizers, in consultation with the participants' organizations, may distribute follow-up questionnaires to help continue the dialogue and for feedback to be provided to their organizations. However, to a large extent, it will essentially come down to the stakeholders themselves to take the initiative to continue their dialogue and to deal with the relevant issues, some of which would have been raised during the exercises [12].

5. Closing statements

The development of exercises such as RAMSETE is naturally an evolutionary process. This article is intended to serve as an introduction to the games that will be discussed in terms of the outcomes of the Think Tanks dealing with the three ESPREsSO challenges (see Refs. [23–25]), as well as being a guide for a reader who wishes to further explore the potential of serious games as policy-discussion tools for DRM, DRR and CCA.

The RAMSETE exercises provided an inclusive forum whereby the participants could openly exchange ideas, experiences and concerns in a manner they may not have the opportunity to do as part of their daily activities, whilst engaging with stakeholders they may not normally meet. Regardless of whether RAMSETE is used as the primary information-gathering approach, or as a prelude to more detailed discussions, it has the potential to be a useful tool in helping open up discussions with regards to developing future DRM, DRR and CCA policies and assessing the efficiency of current ones. However, it must be emphasized that such exercises, including the debriefing sessions, cannot be treated as one-off events (e.g. Ref. [12]). Since it has been commented that gaming exercises assume that the participants will carry with them what they have learned (e.g. Ref. [1]), exercises such as RAMSETE require follow-up actions, where participants, who are interacting with those from outside their usual daily routines, can maintain contact and continue the exchange of ideas and information.

As a final statement, while these exercises focus on information elicitation, there is no fundamental reason why the format followed cannot be used for other purposes. For example, they may be employed for trust building exercises between, for example, NGOs, local authorities and the military, the latter frequently a major player in the immediate response to a disaster event, but where there are concerns about their actions (e.g. Refs. [2,43]). What would be required is to adapt the roles employed, and the relative importance of policy, response and interaction. The format may also be adapted to the training and testing of the participants and relevant response procedures. However, this would require a significant amount of work in order to ensure the accuracy of the proposed protocols (this is a case where answers can be right or wrong) and knowledge of the specific scenario, which would need to be

³ The EC FP7 project, SENSUM (Framework to integrate Space-based and in-situ sENSing for dynamic vUlnerability and recovery Monitoring) developed a scenario training exercise to explore the level of knowledge that disaster management personnel from several countries (Turkey, Kyrgyzstan and Tajikistan) had about remote sensing and GIS technologies for use in pre-disaster vulnerability assessment and post-disaster recovery planning and monitoring (Platt et al., 2014a, 2014b).

much more detailed. It would also probably require a greater number of participants and longer playing time to do such an exercise justice, again raising the question above of whether such an increase in complexity is worthwhile.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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