Validating the network analysis through the dialogue with decision makers

A series of workshops were organized in order to discuss the results of the analysis with both the institutional actors and the community leaders of the L'Aquila case study. The aim of this phase was twofold: we intended validating the results of the analysis. To this purpose, we tried to compare the results of the network analysis with the personal experiences. And, to identify potential strategies to improve the emergency protocol together with the actors, accounting for the results of the analysis carried out in this work.

For what concerns the validation of the results, the key elements and the key vulnerabilities were discussed with the already involved institutional and non-institutional actors. Referring to the key elements, participants agreed with the obtained results, and seemed aware of the centrality of the community leaders. Moreover, the institutional actors found it useful that the adopted methodology can provide detailed information about the role played by each actor in the network of interaction. Specifically, the institutional emergency managers were interested in learning more about the meaning of some graph measures, directly connected with the information sharing process. These measures were used as a basis for starting debating about potential improvements of the emergency management procedure.

Participants were also interested in learning more about the key vulnerabilities of the network. At the beginning of the process, they were aware that improvements in the protocol of interactions were needed. Nevertheless, they were focusing exclusively on the interaction among the institutional actors. The analysis increased their awareness about the role played by the informal interactions taking place within the institutional system and between institutional actors and the members of the community. Using the results of the key vulnerabilities analysis, participants started discussing about suitable strategies to improve the flood emergency management plan, accounting for the complexity of interactions. Specifically, the discussion initially focused on the role of the media. Most of the institutional actors agreed that enabling a more effective bi-directional communication with the community members through the social media would be beneficial for sharing emergency information. The institutional actors were interested in enhancing the capability of the current media channels to collect, store and analyse the feedbacks from the community. Local community members thought it important to be able to help monitoring how an emergency evolves.

In order to enhance the preparedness for flood emergency management, the need to improve the cooperation between institutional actors and the local community was considered crucial. The analyses performed allowed to identify the 'key' agents within the network, identifying the most crucial ones in terms of relationships with the others and capability to move information. According to the results of the discussion, this activity could improve the capability of local population to react in case of emergency in cooperation with the official responders. To this aim, suggestions were made to train the community leaders as "agents of change".

Therefore, the first and most important positive result of the implemented methodology was that institutional actors were more aware about the need to shift the focus from investing economic and human resources in developing innovative emergency information collection tools, toward enhancing the capability of the different actors to cooperate in case of emergency.

Interpreting complexity and ambiguity in relation to the emergency management

The analysis of the results allowed us to demonstrate that the oversimplification of the interactional structure at the basis of the development of formal protocols of intervention, characterized by a strongly hierarchical and inflexible structure, represented a barrier to the enabling of an actual collaborative emergency management process involving the different actors. This was mainly because of its incapability to account for the actual role played by the different actors and for the resources required for supporting the cooperation among them. The official protocol described only a small part of the complex network, that is, the institutional and formal interactions. The collected knowledge demonstrated that, during an emergency, informal interactions were activated even among institutional actors, based on personal and already established relationships. Moreover, the set of information exchanged within this informal networks is often broader than the one defined by the official protocols of information exchange.

The methodology allowed us to map the complexity of the interactions and, through the selection of a set of graph theory measures, to better comprehend the interaction mechanisms influencing the effectiveness of the cooperative emergency response. That is: what information needs to be shared, what task needs to be cooperatively implemented. Moreover, the analysis allowed to us to define the actual role played by each actor, according to the information they bring in the network, and their role in performing the emergency management tasks. The results of the analysis were used by the local stakeholders to inform the debate and to identify potential improvements of the protocol of intervention and cooperation.

The methodology accounted for the differences in organizational culture and to analyse how those differences could lead to different management of emergency information. On the one hand, some institutional actors – e.g. the Murcia emergency management – considered the multi-central structure as the most effective structure in allowing the rapid exchange of information within each level of the organizational structure and between different levels. These actors seemed capable to adapt their information collection strategy to the different conditions, showing resilience to failures of the official protocols of information sharing. Institutional actors with a dense network of interactions – i.e. the Murcia emergency management – seemed to be able to shift from the formal to the informal network in order to gather the needed information. On the other hand, the official responders – e.g. the UME and the fire brigades – assumed a strongly hierarchical structure of the information exchange process. These actors trusted exclusively information flowing from the top through intermediary, and easily recognizable, levels. This is because they needed to reduce the "noise" in information collection. Neglecting these differences could lead to the development of ineffective strategies for information sharing for emergency management. Integrating the Murcia emergency management in a hierarchically structured network could negatively affect its role as

response coordinator. Contrarily, increasing the number of information centres in the responders' networks could lead to the paralysis of their activities. The experiences carried out in Lorca suggested that developing effective emergency management strategies requires a clear understating of the differences among agents' understanding of the interaction network.

Finally, the adopted methodology allowed us to [[emphasize the role of the community in the emergency management phases, and to]] make the institutional actors aware of the need to account for the community members' understanding of the emergency situation. Specifically, the analysis of the community's FCM and the related network allowed us to better comprehend the reasons of the low level of trust toward the institutional information. The community's network has a strong multi- centre structure, allowing community's members to select the more suitable

information sources and activate informal networks of information sharing. This is mainly due to the limited comprehensibility of the information provided through the institutional channels. The analysis of the network allowed to define the central role played by the community leaders in facilitating the flow of information. They represent the actual information centres for the community. This result was [[considered as]] crucial for the definition of potential improvements of the emergency management. Community members, generally not mentioned in the official protocol of intervention, should be instead explicitly taken into account. Specifically, the community leaders could easily act as an interface between the institutional system and the local communities, supporting information sharing in emergency.