Enabling knowledge for disaster risk reduction in integration to climate change adaptation

Deliverable 3.1. Knowledge management system technical report

POLIMI & UNISAVOIE, DWF, HUAI, EURAC, TICONUNO

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Deliverable 3.1. Knowledge management system technical report

Executive summary

Deliverable 3.1 comes at the end of a research process that has investigated within a range of coordination activities the role of different types of knowledge in shaping data collection, information management and decision making in the field of DRR in integration to CCA. The process actually explored different trajectories.

First different stakeholders were identified and defined in terms of their role in DRR and CCA: initially stakeholders were grouped into four categories, private and public organizations, researchers/scientists, and the so called civil society. Interviews, meetings, seminars and participatory workshops were organized with the different groups and mixing them in some events to develop a deeper understanding of the type of knowledge they rely on in their work devoted to risk mitigation and management as well as to see how they position themselves with respect to the knowledge that is produced by other stakeholders. At the end, a rather articulated picture emerged that this deliverable tries to summarize, but which has been already discussed in previous deliverables, such as Del 1.2 and Del 2.1.

Second four living labs were conducted in areas and with administrations with which some project partners had a strong relationship that enabled more profound knowledge exchange and even co-production with respect to the more traditional descriptive/analytical nature of case studies. The living labs constituted a unique opportunity not only for testing ideas, but mainly to develop new understandings not only on the specific issues at stake (flood risk management, damage assessment, earthquake preparedness) but also in the identification of the types of knowledge and knowledge providers that were better positioned to positively contribute to the living lab. Such knowledge was co-developed between researchers and public administrations, by researchers and school teachers, etc.

Last but not least the work with a professional communicator of scientific content helped us understand what scientific journalism can actually do to improve the risk knowledge by wider publics than the professionals who held a direct responsibility in risk mitigation.

The participatory workshops of the project provided the opportunity to exchange views and knowledge among a variety of stakeholders and also created the floor for developing discussions between the project partners who had the opportunity to see in a different light also the work that had done insofar in previous research projects. That was important to develop an understanding of interdisciplinary work among us, writing down what we wanted to do together and how we wanted to achieve actual interdisciplinary work. Also a shared bibliography constituted the ground for better
understanding each other in terms of used definitions and of the goals that each project partner considered important for him/her to be achieved collectively.

At the end, the “technical” ICT experts said a very important statement in one of our last meeting, suggesting that we were actually able to identify in a very clear cut way our “requirements” for the development of a knowledge management system. Even though it was not the intention of the consortium nor it was promised as a project result, as it is beyond the focus of a coordination activity like the one under which the Know-4-drr project was funded, the capacity of the consortium to come up also with rather technical requirements and suggestions for the knowledge management framework to make the achievement of an engineered system less hypothetical than was at the beginning of the two year project. Even though the technical system is not developed at the end in terms of concrete ICT solutions, still a proposal of how such system (or ecosystem as the ICT experts call it) may look like in terms of interface with potential users has been made. Also, the potential users and the way they may interact to exchange and co-produce knowledge in the system has been addressed and a possible solution envisaged.

In order to translate knowledge into action, that is, to facilitate informed, evidence-based decisions taken by all stakeholders involved in DRR and CCA. A knowledge management framework needs to be developed covering all key areas for action mentioned in the Sendai Framework for Disaster Risk Reduction 2015-2030, such as institutional functioning, states, organizational behavior.

Such a framework enables applying lessons from the past, and optimize the public expenditure in communication and information diffusion by enlarging the target subjects. Thus, it will increase efficiency, effectiveness and robustness of future DRR and CCA policy development and implementation, which, in turn will deliver long-term budgetary savings. A prerequisite for a KMF is the provision of guidelines or criteria - in dependence on the given context – that need to be considered prior to taking a decision that is likely to have an impact on a given community and/or environment. This includes all procedural, technical and cultural components in the decision-making process that need to be taken into account for obtaining best-possible results. Also, creating a participatory environment is essential in that respect and can be achieved, as demonstrated in the case of the KNOW-4-DRR project, for example with interactive workshops and living labs.

The KNOW-4-DRR project results emphasize that the design for such a framework should respond to the qualities, such as being accurate, transferable, transparent, open but equally based on reliable data and providing a virtual space for meeting/exchanging, knowledge and “learning”, without having necessarily to be accompanied by someone to navigate in the search of documents or needing to know what to look for prior searching. Besides, it has to be adaptable over time i.e. to adjust for user needs of the frameworks and provided knowledge and to provide demand-oriented packages of knowledge assets and enabling tools, so-called “Knowledge KITs” or “knowledge assets”

With such guidelines and participatory environment, the Knowledge Management Framework aims to:

1) Enhance the production of innovative tools and procedures at the research and operational levels.
2) Involve all stakeholders across levels and tailor knowledge per target group and per context.
3) Build trust and achieve understandable, co-produced, shared and useful knowledge
4) Being relevant to policy makers as to all societal actors - scientists, practitioners and the civil society, and involves them across scales

The final proposal of our own knowledge management framework for DRR and CCA borrows from economy the concept of market, that is a space hosting the exchanges, where the solution of the dynamics among producers, suppliers and demanders obtain the optimal allocation of resources and the best possible results, measured as the maximization of value added and systems’ utility. Moreover, a space where innovative demand may emerge as the result of the exchanges and mutual contamination of market’s community, as in all markets, but here enhanced by the nature of KWDRR as a public good, which means interactions not based on competition but on cooperation and partnership. Then, new KWDRR contents emerge, assuming different shapes in a variety of knowledge assets and enabling tools.

The proposed DRR marketplace is an arena where the stakeholders are called and enabled to “coproduce, develop, and continuously modify the virtual world that expresses their community” by developing a contextualized collective knowledge. The participants to the DRR marketplace are continuously, by their knowledge production, supplying and consumption, learning and in the same time inventing.

In our knowledge marketplace, knowledge is not seen as an object that can be stored, transmitted and transformed independently from the processes of its creation and application, but as a resource intimately related to the way and the context in which it is used. The following figure illustrates the concept showing also how the various stakeholders we have met during the project are often positioned and what type of exchanges are occurring or may occur.

In developing further the notion of the market, we arrived at the conclusion that knowledge kit can be developed within communities of practice that share certain interests and common objectives in one of the disaster related policies. Neither the knowledge kit nor the community of practice have a
definite and close geometry. Instead, they are seen as highly dynamic and changeable. Nevertheless, the idea of crystalizing at a certain moment an idea of the knowledge that is necessary to carry out a certain task or to implement a certain policy or directive proved to be very powerful and permitted to translate some of the activities carried out in the project into knowledge kits. In particular, a knowledge kit was developed for three out of the four living labs (Vietnam, Umbria Region and Po River basin) and for the development of professional communication products for DRR and CCA. An example of such knowledge kits is shown in the next figure, representing the knowledge kit of the Vietnam living lab.

The idea behind the kit is to summarize the knowledge and the information that is necessary to carry out activities similar to the ones that have been conducted in Vietnam to share with locals good state of art techniques while self-constructing their house so as to implement basic safety rules against the heavy winds connected with typhoons. Once the kit is developed and put in a web portal, others that are interested in the same set of issues can either consider what is made available, share opinions about the content and the way the kit has been developed, but also share another kit, change it according to their needs, different legislative and juridical contexts, etc.
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1 Introduction

Deliverable 3.1 comes at the end of a research process that has investigated within a range of coordination activities the role of different types of knowledge in shaping data collection, information management and decision making in the field of DRR in integration to CCA. The process actually explored different trajectories. First different stakeholders were identified and defined in terms of their role in DRR and CCA: initially stakeholders were grouped into four categories, private and public organizations, researchers/scientists, and the so called civil society. Interviews, meetings, seminars and participatory workshops were organized with the different groups and mixing them in some events to develop a deeper understanding of the type of knowledge they rely on in their work devoted to risk mitigation and management as well as to see how they position themselves with respect to the knowledge that is produced by other stakeholders. At the end, a rather articulated picture emerged that this deliverable tries to summarize, but which has been already discussed in previous deliverables, such as Del 1.2 and Del 2.1.

Second four living labs were conducted in areas and with administrations with which some project partners had a strong relationship that enabled more profound knowledge exchange and even co-production with respect to the more traditional descriptive/analytical nature of case studies. We had in mind since the beginning that the living labs could be a place where to test some of the ideas that emerged during the various coordination activities, but nobody was really able to tell what exactly will come up from them and to what extent the integration between the project and the living lab could be pushed. We discovered and it came partially as a surprise, that the living labs constituted a unique opportunity not only for testing ideas but mainly to develop new understandings not only on the specific issues at stake (flood risk management, damage assessment, earthquake preparedness) but also on the identification of the types of knowledge and knowledge providers that were better positioned to positively contribute to the living lab. Such knowledge was co-developed between researchers and public administrations, by researchers and schoolteachers, etc.

Last but not least, the work with a professional communicator of scientific content helped us understand what scientific journalism can actually do to improve the risk knowledge by wider publics than the professionals who held a direct responsibility in risk mitigation. The participatory workshops of the project provided the opportunity to exchange views and knowledge among a variety of stakeholders and also created the floor for developing discussions among the project partners who had the opportunity to see in a different light also the work that had done insofar in previous research projects. Since Deliverable 1.1 an effort was made to create a “community of practice” also among the project teams, considering their different expertise and the contribution they could bring to the project. Actually, we discovered it was important to develop an understanding of interdisciplinary work among us, writing done what we wanted to do together and how we wanted to achieve actual interdisciplinary work. Also, a shared bibliography constituted the
ground for better understanding each other in terms of used definitions and of the goals that each project partner considered important for him/her to be achieved collectively.

At the end, the “technical” ICT experts said a very important statement in one of our last meeting, suggesting that actually we were able to identify in a very clear cut way our “requirements” for the development of a knowledge management system. Even though it was not the intention of the consortium nor it was promised as a project result, as it is beyond the focus of a coordination activity like the one under which the Know-4-ddr project was funded, the capacity of the consortium to come up also with rather technical requirements and suggestions for the knowledge management framework make the achievement of an engineered system less hypothetical than was at the beginning of the two years project. Even though the technical system is not developed at the end in terms of concrete ICT solutions, still a proposal of how such system (or ecosystem as the ICT experts call it) may look like in terms of interface with potential users has been made. Also, the potential users and the way they may interact to exchange and co-produce knowledge in the system has been addressed and a possible solution envisaged.

It required certainly two years of rather hard work to be able to develop the concept of this knowledge management system framework. We could also benefit from the interaction with relevant stakeholders at a European and international level. In fact we were able to contribute to a technical group on damage and loss data working in the context of a DG ECHO mandate: this experience was very valuable to see all the levels that are involved in a task that is generally explored only at a given administrative and spatial scale, that we could see from the top down to the field where damage occurred and up back again. Secondly we could interact with UNISDR experts developing concepts and contributing to the GAR 15 and to the definition of the principles and pillars of the Sendai Framework for DRR; various members of the consortium provided this sort of contribution and were able to report the results to the project, which was indeed very valuable in terms of augmenting the awareness of how knowledge in DRR can be circulated on many different tables.

In this deliverable we try to summarize and build on the understanding we achieved during the 24 months of the project, considering also the valuable constant contribution we had from some members of our Advisory Board who actually acted as promoters of relevant expertise and signaled relevant examples of knowledge management platforms and/or other projects that were in the meantime working on similar issues. We really did not neglect any of the types of knowledge that we considered important when submitting the project proposal; in two of our meetings we were able to invite experts who reflected for example on the juridical knowledge, on how judges and the juridical system perceive risk related issues and responsibilities in highly uncertain domains. The very wide range of different knowledge that we were able to encounter and work with during the project permitted to develop the framework for a knowledge management system that we hope it will be possible to develop fully in a future project and that we deem may be utilized by those who are willing to take similar initiatives in the field of knowledge management for DRR in integration to CCA.

This deliverable is organized in two parts. The first is devoted to explore knowledge management processes in public organizations and in organizations sharing responsibilities in risk mitigation and adaptation to climate change; the second focus on the design of one possible configuration of an IT enabled knowledge management system applied to cases and laboratories developed in the Know-4-ddr project.
2 Knowledge as a process of discovery, understanding and acting

2.1 Knowledge as a process of discovery, understanding and acting

Since the beginning of the Know-4-dr project we suggested that knowledge is not an item, a commodity that can be transferred. It seems no longer effective the development of models and tools for a simple knowledge transmission and dissemination into a wider community, as if it was a system of items that can be moved from the scientific arena into policy-making or be taken into administrative practices.

We had to explore a bit the philosophical background of reflections around knowledge, a clearly impossible mission to accomplish (see deliverable 1.2.). Somehow we have to come to compromise with the much less comprehensive and rich overview of knowledge that is provided by studies, research, and applications developed since the Eighties for business organizations and to a much smaller extent for non-business organizations. This is acceptable as the goal here is not to understand the ultimate goal and modality of knowledge and scientific and philosophical enquiry, rather to provide enhanced models and methods for better sharing, using, storing and innovating knowledge that is “already there” in the field of disaster risk. Our purpose is not to fill all our knowledge gaps in hazardous phenomena understanding nor in how to produce fully satisfactory probabilistic risk assessment and deterministic scenarios. Rather, our objective is to use at best the knowledge we have and to make stakeholders from different organizations, different sectors of society holding responsibilities in risk management and prevention communicate and listen to each other. We wish such stakeholders to share their knowledge, learn from each other, and learn together how to better mitigate and prevent calamities and adapting to the effects of climate change.

Scientific investigation is not the only way to create new knowledge, the latter can be created also learning from practice, from how to do things, from developing collectively new understandings, new definitions for concepts, new ways of using them in a given field. This has been generally indicated in the organizational and business literature as “know what” rather than “know how”, as well as establishing different grounds that can lead to innovation and creation of new knowledge: rational reasoning, intuition and creativity, or distinguishing between tacit and explicit knowledge (Polany, 1966).

According to most scholars, knowledge is not a “thing”, but a process, knowledge is in the meantime embodied in individuals and created socially. Which means on the one hand that knowledge cannot be detached from knowing and from the knower, every time knowledge is taught it needs to be reinterpreted and reconstructed in the mind of the learner. On the other, it means that the knowing process does not occur in a vacuum, it is intrinsically social.

Considering definitions that have been developed and applied to knowledge management in organizations and in the business sector, in the project we have used in particular that provided by Marc Zeleny (2006). According to the latter: “Knowledge is purposeful coordination of action”, and therefore it is a process that is recognized and validated socially. “Knowledge is based on both the outcome and the process leading to it”. Knowledge refers to “Know how” and to “know what” action should be performed. In the latter regard, “action is the result of deliberate decision making within new contexts and circumstances” whilst “behavior is a habitual or automated response to repeating circumstances within a known context”.

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In the field of disaster risk and climate change, such definition of knowledge has some immediate repercussions: we know if we are able to act so as to mitigate, reduce, avoid the impact of extreme phenomena on cities, regions, communities. We know if we can translate into actions what the knowledge and the information about not only hazards, but also exposure, vulnerability, response capacity suggests in terms of expected damage reduction measures and interventions. This actually is in line with the article by White et al. (2001) that has been quoted so many times in our project but also in recent literature: failure to build on enhanced knowledge on hazards and risks is to be blamed on institutions, private citizens, organizations with different levels of responsibilities who were not able to implement risk reduction policies and measures, starting from raising communities preparedness to land use planning, effective application of building codes, etc.

In his work, Zeleny always stresses the point that knowledge is different from information, for example in one of his papers (2004) he writes that differently from knowledge, “information is symbolic description of action”, “information is only one of the inputs into the process coordination” that is knowledge. This is the reason why there can be information overload but there cannot be “knowledge overload”.

The idea that the different components of what makes knowledge possible should be defined separately and related to each other in a practical manner goes back to a discussion that is ongoing since the Seventies regarding the so called “knowledge pyramid” (see Figure 1).

In box 1 the specific definitions are reported, mainly based on the paper by Davenport and Prusak (2005).

The initial idea proposed by Acker in 1988, has been revisited and reinterpreted by authors who suggested to break its rigidity, recognizing that there are many feedback loops in the data-information-knowledge “pyramid” (Davenport and Prusak, 2005; Frické, 2007; Jennex, 2009). This is the reason why the arrows in the pyramid do not go only bottom up but also top-down, as knowledge is needed to search for the more useful data and information. The idea that the figure requires some circularity in its interpretation and not a linear relation was already recognized by Ackoff himself, when he wrote that managements’ most critical need is not for more relevant information, but rather for “less irrelevant information”. In fact, “the only condition under which we know what information
is needed to solve a problem is when we have a complete understanding of the entity that has the problem, its environment, and their interactions. There are few cases in which such complete understanding exists”.

**Box.1. Definition of data, information and knowledge**

Based on Davenport and Prusak’s (2005) discussion, the following classification can be proposed:

**Data**: is a “fact”, an individual event; “in general it can be said that there is no meaning in data”. As an example: for the risk assessment, the data used is often a digital terrain model, rainfall data, data on historic flood events. “Data describes only a part of what happened, it provides no judgement or interpretation and no sustainable basis of action”.

**Information**: “is a message, in the form of a document, audible or visible communication”. In fact, in Latin it means: provide with form, with a shape. Unlike data, information has a meaning. Davenport goes on suggesting that there are 5 ways in which data can be transformed into information:
- Contextualized;
- Categorized,
- Calculated,
- Connected,
- Condensed.

The outcome of the risk assessment is information in the form of vulnerability, hazard and risk maps, tables and reports. This information must then be transferred to the users and decision-makers, making use of appropriate communication channels.

**Knowledge**: according to Davenport, “knowledge is a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information. Knowledge can be seen as both process and stock”. There are many ways in which knowledge is created, some imply:
- Comparison;
- Consequence identification;
- Creating connections;
- Conversation.

To achieve prevention and mitigation, the output from risk assessments is used to understand where the high risk areas are and what are the best mitigation measures - either through technical measures (engineering works) or organisational measures (e.g. urban planning). Created knowledge can be partial or unsatisfactory, because for example it does not include relevant aspects, such as vulnerability assessments. Knowledge limited to the hazard factors provide less options in terms of actions that can be taken.

What is important again for us is to stress the difference particularly between knowledge and information, as speaking about knowledge management systems we do not mean databases or information systems, but somehow higher order systems allowing to navigate among databases, and use IT to tag, identify, share, store and produce knowledge available or to be developed on a specific matter related to disaster risk reduction as will be discussed later on.

The two-year project permitted to explore the Data-Information-Knowledge-Wisdom pyramid (Ackoff, 1989) with respect to each stakeholder category needs, interrogations and understanding and therefore in an integrated way facing the whole DRR process as a flow of activities that produces
and needs knowledge. From these activities we came out with knowledge about knowledge: 1) a representation of the categories of knowledge that are involved in DRR and 2) certitude that DRR knowledge management is a complex process that may permit the emergence of a new configuration for knowledge enabling.

### 2.2 Knowledge bound within community

As suggested by Jennex (2009), “KM is not trying to capture all knowledge or wisdom. Rather, knowledge management targets specific knowledge and wisdom needed by an organization to perform a specific task”. Because knowledge is a socially constructed process that is embodied in an individual and recognized and shared in a community, that can be as large as a the “scientific community” or as small as a village keeping the oral tradition about signs that permit to forecast weather or other natural phenomena for example, knowledge management cannot be actually developed at large, globally, without reference to the community of peers for which such management will make sense. As mentioned before, the community can be small or large, but in our view there cannot be knowledge management in general, with no specification of the community (is) and the practice(s) for which it may be of use.

It is the community, not the management systems that can decide to share, remember available knowledge and create new one. It can be suggested that all those actions of sharing, remembering, creating are part of larger processes that are socially constructed. In this regard the system, whatever system, can enable sharing, storing and producing, but cannot substitute the human and social process itself (McDermott, 1999).
3  Stakeholders’ knowledge and knowledge types in DRR and CCA.

3.1  Stakeholders groups as identified in the Know-4-drr project

Already in the proposal stage it was decided to group stakeholders to be considered for any knowledge management policy into four categories: scientists, public sector, private sector, and “civil society”. This categorization has been at the core of many discussions, as it looked since the beginning relevant but also somehow inappropriate and not fully satisfactory. For example it was contested by some project partners that scientists cannot be considered as a separate group, as they may work for all of the other three groups, being private consultants, support citizens’ group in sometimes-controversial issues, or as very often work for public research centers and academia. Further, in the field of risks, it was also suggested that often scientists working with a public mandate to support decision-making and risk governance need to find a different balance in their theoretical/practical orientation. Not only because their research needs to be translated into norms, standards, decisions, but also because by doing so they become involved into sometimes harsh value and political issues.

On the other hand, the so called “civil society” is in fact a non-coherent mix of citizens’ associations, parties, NGOs with different perspectives and interests when it comes to environmental issues, including risks and climate change. Private bodies are also more diverse in their private/public nature than one may think of. Lifelines managing companies are often private and make a revenue out of the service they provide, they conform therefore to the notion of firms making a profit out of their business. However, they are subject to very strong public regulations and to significant constraints as they have to guarantee the functioning of the service which per se is considered as a “public right” that need to be safeguarded even under very extreme conditions. Insurance companies also provide a rather large spectrum of behaviors. They are commonly considered as reluctant to share their data; however, the recently established ONRN platform in France represents a very relevant example of cooperation between the State and the insurance sector in providing information and knowledge on risks and compensated events in different regions in France.

Even though the distinction among the four categories is not so satisfactory, it proved to be useful to navigate in the rather complex arena of disaster risk and disaster risk knowledge management. It permitted to investigate the type of knowledge that is most frequently developed and asked for by stakeholders pertaining to the different groups and also allowed for better recognizing the different types of knowledge that must be considered, apart from “scientific knowledge”. The four groups categorizations was helpful in that it encouraged to investigate also knowledge production, sharing and archiving in each group, that is in its turn further divided and articulated.

3.2  Knowledge types in the DRR and CCA fields

Knowers that pertain to different groups also hold different types of knowledge that we have categorized as the following: scientific, organizational, regulatory, and common. In the following we provide a brief description of the four knowledge categories.
**Scientific knowledge:** This epistemic knowledge includes both scientific and technical capacities that mutually exchange now solutions, now problems (Canguilhem, 1965). DRR scientific knowledge is obtained ‘through study or practice’ where ‘science is considered in its widest sense to include the natural, environmental, social, economic, health and engineering sciences ...’ (Southgate et al., 2013).

Rescher suggests that science aims at four distinct goals (Figure 2).

![Figure 2. Goals of scientific investigation according to Rescher (2007)](image)

Rescher also suggests correctly that science is not a collection of knowledge, but a ”system for creating it”.

The construction of the DRR scientific knowledge is hence a process of reciprocal adjustment between theory and experience in an interdisciplinary space (Lecourt, 1974).

**Organizational knowledge:** This taxonomic knowledge defines the DRR organizations (i.e., public and private sector) learning process. As for the organization theory, it is a procedural knowledge expressed as a set of routines resulting from an accumulation of experience that lead to future behavior (Levitt & March, 1996). These routines include the operating forms, rules, conventions, beliefs and technologies that shape the organization design and its operational behavior in designing, developing and performing solutions for DRR. The organizational knowledge may be considered as the “know-how” of organizations that goes from the knowledge of how to how best when KWDRR becomes a source of competitive advantage (Edmondson & Moingeon, 1996). It is important to underline that the choice to build up DRR solutions may not be part of the priorities of organizations resulting in a resistance to the policies.

**Regulatory knowledge:** This axiologial knowledge is the expression of the regulatory function of public administrations and agencies assigned to implement risk mitigation policies through the production of laws, norms and procedures. DRR regulatory knowledge defines the regulation measures and the role of governance organisms that ‘seek to control society and individual conduct’ suggesting a ‘set of moral and political-process consequences associated with this kind of governmental commitment’ (Lowi, 1972). The validity of regulatory knowledge is time and space dependent prescribing the scope and the limits of the DRR
policies. The DRR regulatory knowledge may be seen as the expression of the DRR politics at different levels of governance.

**Common knowledge:** This knowledge is related to the notion of doxa as common knowledge and shared opinions and assumes for DRR a ‘spatial’ characterization, i.e., community-based, vernacular, local. DRR common KW comprises both collective significance - as it is shared among a group of persons- and psychological individual acceptation (Girault & al. 2010). Usually considered in an opposition relation with scientific KW common KW is generally orally transmitted and has no ‘formal’ formulation. DRR common KW encompasses both stereotypes and clichés and deep knowledge of the territorial context, its risks and the traditional behaviors and techniques worthwhile to cope with them. Today, DRR common KW is challenged by global threats that require its integration into a more ‘globalized’ knowledge.

The analysis of the knowledge flows among DRR stakeholders within KNOW4DRR project case studies and living labs, permitted to apprehend that the four sectorial knowledge categories namely scientific, organizational, regulatory and common knowledge rarely communicate together. The KW fragmentation is not only the result of a lack of communication among the knowledge holders (i.e., DRR stakeholders) but of the absence of frameworks permitting to transfer part of the knowledge of the one and embed it into the knowledge of the other. It is therefore important to explore what does it mean to make different DRR knowledge categories communicate, influence and transform each other. Table 1 describes these interactions as binary relationships using the results of the analysis of the project outcomes, theoretical and case studies from the literature. This effort of describing how DRR knowledge may transform when it encounters another knowledge category produces a bidimensional representation leading to simplify and therefore to flatten the perpetual circularity of this mutual transformation.

Table 1 lists a non-exhaustive list of possible influences that the four types of knowledge may exercise one on the other when they interact with specific regard to our main objective: enhancing DRR understanding and awareness.

In order to complete Table 1 we considered the findings that result from literature review, eleven case studies and four living labs of the project. Such findings suggest that a rationalization of disaster risk reduction management and a much stronger and coherent integration between agencies responsible for disaster risk reduction and climate change adaptation are a primary condition for better coordination and sharing of data, information and finally knowledge (Norton, 2014).

Table 1 has been conceived as a matrix where different possible interactions between types of knowledge are considered; in the table the result of such interaction is represented in two ways that reflect the result of the interaction itself. The (+) sign indicates a positive interaction that produces as an outcome enhanced understanding, improved tools for decision making and action, better definitions and more mature concepts. The (-) sign refers instead to barriers to the integration of the two types of knowledge that interact in a given cell and that may be due to resistance of each type of knowledge to change or to context related constraints, that may be political, juridical, linked to the way careers are conceived in the academic world, etc.

In the table reference is made to some of the case studies for which the flow of knowledge and information was mapped in Deliverable 2.2.
Just a couple of examples for clarification. When the scientific KW meet with the organizational a positive result may be the reshaping of organizational procedures, strategies and priorities. In our eleven case studies and in the living labs we have seen this several times, particularly after disasters. In fact emergencies and disasters fosters the interaction among different knowledge bearers and create an environment that facilitate the interaction among different types of stakeholders who hold different knowledge. The rethinking and change of procedures or organizational strategies and priorities that did not correspond anymore to the reality after the disaster, as the latter showed the limitation of previous arrangements has been witnessed after the Elbe Flood in 2002 for example, when the BBK Academy was created not only to provide training and educational modules to operational units of civil protection, firemen and police, but also to provide for them an opportunity to meet and learn from each other. In the Umbria case, the 2012 flood gave a significant impulse to the co-development of forms to survey residential and industrial buildings damaged by floods as well as to embed in a renewed procedures the informational needs of both administrative authorities and scientists. The idea of a procedure to collect and analyze post disaster data to satisfy multiple needs and purposes comes from the interaction between stakeholders that are more interested in improving risk models (researchers) and stakeholders that need to account for losses and ask for compensation (civil protection officials). In both cases changes deriving from the interaction between types of knowledge encountered obstacles and resistance due to predefined protocols and to prior organizational arrangements. In the case of the BBK Academy the idea of creating a place to teach and learn about how to deal with emergencies was initially seen with skepticism by many; in the Umbria case there was the need to convince different actors that sharing data and information is making their own effort of collecting them much more useful and usable for decision making. We are still struggling with lifelines managing companies to make them share more openly data regarding damage they have faced in subsequent flood events in the Umbria Region.

Another example refers to the interaction between regulatory and scientific knowledge. On the one hand such interaction has triggered the development of new types of expertise, as the one required to be an expert advisor in a court; on the other, scientists are now considered responsible in legal terms for the advice they are providing to decision makers and to the court itself, creating a resistance to get engaged as this may entails becoming liable for very critical advices given in highly uncertain environments and situations.

As a final example we may consider the interaction between common knowledge and organizational: citizens are less seen today as having only a passive role in disasters as it used to be in western countries some decades ago and are increasingly involved in emergency management, as volunteers. ICT has certainly expanded the capacity of citizens to intervene providing useful information web mediated. This positive contribution may become also an obstacle to effective deployment of structured agencies as international aid or civil protection organizations producing an overload of uncontrolled information. In addition, there is a resistance of structured originations to involve citizens in operations, partly because of the false myths that persist in the governmental response to disasters (see Wenger et al., 1975).

In the examples described in detail derived from Table 1 the stress was on the types of knowledge, on their interaction, considering the core characteristics of each type of knowledge. There is a certain correspondence between knowledge types and knowledge owners as depicted in the four social groups that we have identified in paragraph 3.1 and in particular: researchers mainly
hold scientific knowledge, public sector servants are more competent in regulatory and organizational knowledge, private sector workers in organizational knowledge, and finally common knowledge is

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Table 1. Outcomes resulting from and obstacles to the interaction between different types of knowledge with reference to the knowledge flows mapping carried out in Deliverable 2.2
generally associated with the so-called civil society. We need to point out that the knowledge that is considered here is specifically that related to CCA and DRR.

Of course, individuals and groups pertaining to the four macro-sectors that we have just characterized do not hold one type of knowledge or another in an exclusive way but rather in a prevalent way. For example, researchers held mainly scientific knowledge, but many are fully aware of organizational aspects, when they work for the civil protection, for example and/or of laws and norms governing the adaptation processes necessary to implement in practice construction modalities that they have contributed to define as safer and more resistant. In the meantime, by being also lay citizens, scientists are also imbued with “common” knowledge to a larger extent than would admit.

On the other hand, public administration officials are much more familiar than scientists are with procedures and regulatory forms, but may be equally knowledgeable also in scientific issues concerning hazards and risks for which they are expected to develop and implement prevention strategies.

In Table 1 the results of the interaction between types of knowledge that are characterized differently in terms of more used concepts, style and mode of development and stabilization, core issues that are known, is considered. The essential and intrinsic characterizing features of each type of knowledge make it easier or creates barriers to the interaction with others. On the other end it cannot be forgotten that in order to make knowledge types interact real people who bear the different types of knowledge need to interact. Such interaction has strong social and individual components: the attitude towards the others, the ability to recognize and respect each other’s expertise is essential in shaping interdisciplinary work that basically means that experts in different disciplines interact, by making the type of knowledge they hold open to the inputs coming from the other. This is in essence the idea of Table 1. Still the double component of intrinsic knowledge types, rules for certifying its value, and mode of acquiring on the one side and of the people having a specific knowledge because they pertain to a given social group on the other has to be kept in mind when we talk about bridges and barriers to the interaction among them.

3.2 Knowledge boundaries

As convincingly commented by Carlile (2004), the dynamism in knowledge sharing and production derive also from the differences in knowledge among groups and subgroups. In fact, across the know-4-drr activities, it was relatively easy to recognize that boundary conditions and interfaces exist not only among the four stakeholders groups but also within each group among scientists with different disciplinary background or agencies with different missions, etc.

Carlile’s reflections draw on a private individual business, but they are clearly even more relevant when multiple organizations and actors are on the scene. Carlile distinguishes three types of boundary conditions:

− syntactic or informational,
− semantic or interpretative,
− political or pragmatic.

The first type, “syntactic or information processing boundary” is encountered when there exist a knowledge “quantitative” gap among actors, or the qualitative differences easily complement each other, so that transfer of knowledge from one group (sub-group) to another may easily take place.
This occurs in training sessions when novices are thought about some type of risk management issue or when different organizations put in common information and databases. The second type of boundary condition is more relevant, when knowledge is qualitatively different to the point that meanings and definitions need to be discussed and agreed upon, defined by Carlile as “semantic or interpretative boundary”. In this case actors depend on each others’ knowledge and need to come to an agreement about the use of terms if they want to positively collaborate. Carlile quote Malone and Crowston (1994) who define coordination as the management of dependence among activities and resources. Knowledge can be considered as both an activity (knowledge in action) and information as a strategic resource.

The third type of boundary is the toughest one is the “political or pragmatic boundary”, where knowledge needs to be transformed through negotiation and new forms of agreement among actors must be found. In this light a number of assumptions that are common in the “disaster community” should be discussed in a more critical way. For example the idea of “interoperability” that is implicit in the Inspire Directive suggests that data can and should be shared thanks to enhanced technological solutions. However what the application of the Directive has not fully envisaged until now is the fact that in the disaster community for example data and information regarding the apparently same topics are measured and assessed in very different ways, so that even the apparently simple exchange of data cannot take place. What is needed instead is either a new agreement on terms or the transformation of knowledge through negotiations among stakeholders, with the inevitable repercussions on the attached set of data and information.

Another assumption that can be often encountered relates to glossaries of terms: it is often suggested that by creating a new, more advanced, shared glossary of terms, issues such as conceptual disagreements can be solved. However, also in this case, what actually occurs is that one or two organizations are recreating their own knowledge and for their purposes the glossary works well. However, whenever the glossary is transferred to others, the process of negotiation that originated it should be re-created, or the transfer will not be successful, as the agreement or disagreement on terms depends on the risk models each discipline, each stakeholders’ group has in mind.

Therefore, in the Know-4-drr project we came to the conclusion that such a renegotiation of knowledge, so as to be able to provide effective knowledge management one has first to identify the community of practice, the context within which one wants to apply any type of knowledge management system.

The existence of boundaries that can more or less easily transformed into interfaces between stakeholders’ groups has proved to be very concrete in the simulation of a flood that was proposed to the participants of the third project workshop that was held in Bonn. In the latter participants were asked to provide solutions in terms of pre-event mitigation, emergency management, post-event recovery before, during and after a simulated flood that was designed taking as a reference the real flood that occurred in the Elbe catchment in 2013 and in particular in the city of Halle. Participants were divided into two main groups: technical experts and decision makers on the one side and representatives of the local community on the other. The first group was comprised of both scientists, private stakeholders such as lifelines managing companies, public authorities and decision makers. The participatory activity were organized by Principi Attivi, that has already developed experience in the field of conflict resolution in other EU funded projects. (http://www.focus-lab.it/guarino/)
makers. Some participants were somehow representing themselves as in the real life they are public authorities, civil protection officials, scientists consulting for the local or regional government, etc. What emerged very clearly from the simulation is that significant differences in knowledge, in meaning attached to terms, definitions, models and decisions existed not only between the technical and decision makers stakeholders and the citizens, but also within the first group. Also the capacity of stakeholders to use at best their own knowledge and to compromise with others’ perspectives proved to be very different and significantly influencing the type of decisions that were or were not made.

The simulation allowed to elicit several issues in terms of relevant knowledge for decision making under stressful conditions, not only in the time of crisis but also during recovery and in pre-event mitigation.

First, different stakeholders interpreted differently the problems that originated the risk before and the disaster later. Second they had different ideas about how mitigation and response measures should be prioritized. Third it was clear that agreeing about priorities implied first to negotiate about how the event and its root causes had to be interpreted and understood and what were the most relevant and effective solutions.

In the simulation an important role was played by actors that were migrating from one group to another to observe but sometimes also to provide to one group some insight about what other groups were thinking and doing.

The moderators pertaining to the “Principi Attivi” Association who have experience in real conflict solutions around mitigation measures for floods in various regions in Italy managed the entire process as a series of iterative cycles of discussions where a converging set of solutions was approached cycle by cycle. This actually simulates a real condition in which actors have to come to an agreement not only on the solutions but first and mainly about what are exactly the problems and how they should be framed at best.

3.4 Knowledge management models

3.4.1 The origin of the knowledge management concept in the business sector

One of the most compelling answers to the question why at a certain moment in history business organizations have started developing knowledge management system has been found in an article that was actually meant to deal with knowledge management in the environmental and risk field. McGlade and Van den Hove (2014) in fact suggest that in older times people were as knowledgeable as today, just their knowledge was apt to live and act locally (p. 415). Today, instead, markets, cultures, information, people confront with a global world. Global and local problems interact in unprecedented ways, networks of goods, people, knowledge and information repositories are much more interconnected than ever before, posing significant challenges not only to those in need of acting, but also to those in need of finding answers, information and the “right” knowledge to the issues at stake.

Today’s companies are often scattered over large territories, with branches specialized in specific production, with a large number of workers who need to interact with each other for specific projects or on ordinary basis. Technologies have enabled long distance continuing communication, permit to form teams overseas working and modifying the same documents. However finding the “right”
knowledge has become more difficult, as you cannot anymore simply turn to your desk mate or to the person in the other room at the end of the corridor. Specialization of work, changing configurations of teams depending on projects to be accomplished, requires also flexibility in gathering and collecting every time new information closely related to the new problems or items that are confronted. Clearly access to timely information, evolving knowledge and continuous change in teams and projects to be dealt with is a need that is not equally felt in firms. High tech companies, for which knowledge and innovation is vital, are certainly at the edge of this movement, but as literature shows also more traditional businesses (like car production) have become increasingly competitive and therefore the extra value of a given production is often provided by knowledge, creativity and design.

In such a context, the old way of transmitting knowledge from expert workers to the novels physically sitting close to each other is no longer the only one. In today’s firms, one individual person may have to consult several experts in order to obtain all the information required to accomplish his/her task. Furthermore, tasks to be performed may change, thus requiring different experts to be consulted at different times to acquire the necessary new knowledge. Experts to be contacted may be physically located in different places, sometimes at miles distance, and often pertain to different units of the same organization.

Particularly in some types of businesses, in some sectors, the need to manage knowledge in a different manner and more effective than in the past requires useful and usable means. In order to accomplish given tasks, modern workers need to know not just what to do and how to do it, but prior to that where to find guidance and information on what needs to be done, how. Novels, but sometimes even people with expertise but in charge of new tasks or innovative tasks, need to find as much more guidance and examples as possible to feel comfortable in accomplishing their own task. Relying on others’ expertise to complement your own has become the rule. This implies that nobody can be focus on one closed system in an exclusive way; complex tasks require an understanding of the overall picture that was perhaps not so vital when systems were simpler and especially linear. Further, it means that people need to coordinate their own knowledge to fulfil their task: nobody can consider him/herself anymore as completely independent from others.

All we have explored until now is the need for individuals inside complex organizations to learn and acquire information and knowledge to perform their own work. However a whole body of literature is devoted to organizational learning, that is to how organizations as learn and innovate. Actually those are two distinct issues though strongly connected.

Organizations learn when they are able to acquire new information, new knowledge from different sources, including their own experience. Failures for example should not be seen only as negative, as they may become part of organizational learning, if organizations are able to capitalize from good as well as from negative experience and change wrong behaviors, rules and actions, and maximize instead correct behaviors, rules and actions (Roux Dufort, 2000; Longstaff, 2010). Organizational learning require also specifically designed tools, that facilitate circulation of information, appraisal of experiences and discussions about what needs to be changed and what proved to be strategic for organizational good performance.

Innovation is perhaps something more than learning: one can learn from others and simply imitate what others do, having learnt processes and mechanisms of functioning; to innovate instead, creativity and capacity to develop new ideas and new projects are required. In other words, creative learning is necessary to innovate, as it does not only build on previous and well established knowledge, but it
entails the capacity to merge different concepts, to extract new contents that were not necessarily included in the ideas and concepts that were previously acquired.

Last but not least, it must be also recognized that in contemporary times the quantity of what needs to be known has increased dramatically too, to the point that keeping memory of the large quantity of information, concepts, experiences, lessons learnt from past projects and work has become a challenge per se.

Legislation, rules are also changing faster than in the past, so that the old way of professional able to keep everything in their own mind is no longer viable. There are still people who work like this, for example in public administrations, where old servants constitute the living memory and possess the knowledge needed to make things functioning in the organization. However the criticality is easy to recognize when they leave the organization nobody is able to replace them and all their knowledge is gone with them. So, even though their contribution and their capacity is invaluable, their way of working is not making the organization neither efficient nor effective, as their knowledge does not become a capital for the organization itself nor for the new generations that will continue their work. New ways of cooperating and coordinating must to be put in place and acquired by practitioners, to better cope with modern professional requests. Such change is already occurring in the private sector, it is important that also the public sector gets aligned to the new necessities arising from a highly dynamic world where it will be increasingly difficult also for public servants to remain in the same position with the same tasks for their entire professional life.

3.4.2 Current models of knowledge management in scientific research

In modern scientific endeavor it is almost given for granted that this type of investigation is collective, even though may be restricted to a close, small number of people. Ways of knowledge management in modern scientific investigation include peer review of articles and books that present results of research. In the last years there have been critiques to this system raising from different grounds (see Trench, 2008; Lee, 2006). Such critiques can be applied also to research in the field of natural hazards and disaster risk management. First the tremendous pressure that has been put in the last years to publish in academia as a mean for achieving a career. Such pressure is having some negative effects: too much is published and against the capacity of researchers to read what is published in any domain; and quantity comes at the expense of quality.

Despite the peer reviewing process, that probably worked well in a world where the scientific community was relatively small, the quality of what is published may be rather poor, not to mention the fact that even high ranking journals with an outstanding reputation, like Science and Nature are obliged to withdraw every year tens of articles that proved to be false when put at the scrutiny of a larger public than the initial reviewers. Scientific fraud has become an issue and is certainly also the result of this dramatic pressure to publish.

Even without fraud, scientists, particularly younger ones, end up with publishing several times the same research in different journals, changing some minor details to justify for the new paper; research is often published when full results are not yet available at the expense of the same research, etc. In some regards the all system of publishing, ranking journals, reporting the number of citations, seem to advantage more the fewer and increasingly powerful editors’ economic sector rather than the scientific endeavor (very much in line with our thoughts see Trench, 2008).

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The number of scientific journals on the same topic has increased dramatically in the last years, making publishing less competitive as it becomes easier to find at the end one journal that will publish research that others have rejected.

The way of financing publications has also a role in all this. Getting access to articles in the e-bookstores is tremendously expensive creating a divide between rich and poor countries and regions in terms of capacity to pay the high rates required for electronic access. Laterally it has also created a large black market of illegal sites for downloading at the expense of remuneration of authors’ work, as it is the case for all downloadable products from music to movies to books.

The other possibility, getting free access journals require that authors pay rather large amount for publishing, creating again a new divide between richer and poorer countries in terms of possibility to publish and therefore make their research known in journals and series with high reputation.

The increasing number of journals is also the result of further specialization on the one hand and the call for more interdisciplinary work on the other.

The research community is dividing among those who continue to pursue very specific, hyper specialized investigations and others that devote their work to “interdisciplinary” work and find new “interdisciplinary” journals where to publish, probably at the expense of an innovative common way of understanding scientific and research questions while making also the interdisciplinary work a sort of new “specialization” or sector.

In a rather interesting contribution to the second issue of “Late lessons from early warnings” of the EEA, Grandjean (2014) counts the number of scientific papers dealing with potentially highly toxic or dangerous new chemical substances. He found that a very limited number deals with new substances, highly unexplored, whilst the majority of articles focus on already well known and since long studied substances. This has clearly to do with the academic reward one can get by trying to publish on a new topic with respect to a well-established one. Similar considerations can be (and actually have been) put forward regarding highly interdisciplinary contributions, that require a very wide range of expertise to be reviewed and also offer a synthesis of different branches of knowledge and expertise that is difficult to judge based on the individual background of each reviewer.

Yet sometimes, complex environmental and risk issues clearly require the convergence of different cultures and disciplines, that are not yet so acquainted to work together mixing and merging their knowledge as would be required and as is often mistakenly given for granted (Lélé et al., 2005).

Those facts have to be borne in mind when thinking of how to make other stakeholders apart from scientists more aware of recent discoveries and results of research that may be of use in their own work and in deciding the best ways to mitigate natural risks or adapt to climate change. And we have already said that the readers of scientific journals are mainly other scientists, often of the same disciplinary field, and rarely others; while other stakeholders will read such journals only after having been advised to do so in interpersonal communication (Menoni, 2010).

And this is rather comprehensible as stakeholders with other responsibilities than studying cannot afford navigate in the vast ocean of what gets published before encountering what is really useful for them.

3.4.3 Applying the knowledge management concept in the risk management field

The idea and applications of KMS in businesses are not new as we have seen in the previous paragraphs. They are though in the field of disaster risk management. Very few examples are provided
in literature as shown by Dorasamy et al. (2013) who published a review of the 51 papers discussing knowledge management in the field of disaster risk they were able to find going back twenty years with respect to when their article came out. Not only few examples of KMS are available in the risk management arena, but also research and experiences they were able to find are mainly addressing crisis and emergency management rather than prevention or mitigation in a wider perspective. It makes therefore sense to ask why. In the discussions along the project and in our own investigations we found a number of reasons for this.

First, it should be pointed out that knowledge management looks rather different in businesses and in public organizations, such as those with responsibilities in DRR and CCA. In fact, whilst in business knowledge management occurs within the same firm, or in branches of the same firm, the situation in public administrations dealing with risks is rather different. Several organizations share responsibilities in risk prevention and management, together with private entities, such as for example lifelines services providers or insurance companies. In such condition, goals are only loosely defined: prevention or risk mitigation can be set as a general common goal, however concepts and understanding of how the latter has to be achieved are not totally overlapping, actually sometimes diverging rather significantly. In the first workshop of the project, held in Bolzano, Italy, in December 2013, the Flood Control Game developed by a group of young students within a project at the University of Rotterdam was played by the participants. Some were stakeholders with real responsibilities in flood management and civil protection. The game permits to elicit very clearly the situation in which different agencies, stakeholders, social groups have different mandate that make them act differently in the face of an impending risk. Even though they should save the city from a larger flood, their strategies and tactics are not fully complementary, nor fully coherent with each other. This makes the fight against the flood very challenging and undetermined at the beginning as it will really depend on the level of collaboration the various stakeholders will be able to establish among them. One thing that emerged very clearly from the game is that also in terms of knowledge priorities involved agencies, public administrations, officials have different perspectives and understanding. Any knowledge management in the field of disaster risk needs to take this situation into careful consideration: any set of tools that will be designed will need to adapt to systems that are by definition open and where goals are only loosely commonly defined.

Another important difference between firms and public agencies is in the immediate translatability of the organizational goal into something concrete and tangible. In the former in fact, production of a given object or service is easy to define; in the latter, the guarantee of “safety” as a public good is a rather generic goal, that can be interpreted in various ways, different “objects” and services may correspond to such goal and actually the various authorities, stakeholders that we have mentioned above have sometimes rather different ideas about what concretely the goal of “safety” may mean.

3.4.4 Examples of knowledge management in the field of risk mitigation and climate change adaptation

In this respect a rather interesting example of knowledge management has been developed by the Life Saving at Sea organization in Norway. To satisfy the knowledge needs of the volunteers who become

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2 Project workshop on Working and playing on the theme “uncertainty” in crises situations, 10 and 11 December 2013, EURAC, in Bolzano
very skilled and professional in their high-risk endeavor, several requirements must be met. In particular when it comes to teach a skill to newcomers or when new knowledge acquired under extraordinary circumstances has to be shared with the entire group. It is vital for all members with different functions to share such knowledge particularly to manage what Carlile (2004) defined as “knowledge dependency” which acquires a very concrete meaning when the life of rescuers depend on each other’s intervention capacity. So, for example, managers have learned from rescuers under rush sea conditions what works and what does not in a boat and suggest requirements accordingly when new boats have to be bought or old ones to be retrofitted.

As relevant as this example can be for the DRR field, we still must point out that in the latter not just one, but several organizations are concerned. Organizations that interact on an ordinary basis only partly, that are only partially familiar with each other and still need to learn both as single entities and together.

In this respect a rather interesting experience has been reported in a research carried out in Sweden among municipal agencies in charge of defining climate change adaptation measures. In the latter the capacity and practical results of policies to implement the climate change adaptation policy set both at a national and local level in Sweden has been investigated. Results show that even in the city of Goteborg that is perhaps the most advanced in setting climate change adaptation policies and strategies, some drawbacks are still very evident. First, even though an intersectoral committee among agencies and offices of the municipality was created to define guidelines for climate change adaptation in the city, it was not well integrated in the ordinary organizational structure of the municipality. Its mandate was somehow vague and the results of its work were later shared in a rather haphazard way rather than made publicly available to anyone potentially interested.

Further, it appeared evident that whilst the technical agencies have both a clear mandate and high capacity to put in place structural measures, whilst non-structural mitigation still had a rather weak role. So for example whilst sea barriers and levees are well designed taking into consideration also the potential effect of climate change on the flood risk in the city, one very low area close to the train station has been designated for further residential and commercial development despite of its being one of the most risky area in town. The article concludes with relevant remarks related to the importance of managing better knowledge across sectors, offices and agencies, to make adaptation to climate change a common issue to be implemented in ordinary policies and not only in special, sectoral policies. This recommendation has been suggested for long time also regarding non-structural risk mitigation against natural hazards and risks, reinforcing the call for tighter links between both scientific and other stakeholders groups acting in the disaster risk prevention and in the climate change fields.

Examples of closer cooperation among communities and the need to make scientific knowledge more “ready-made” for different decision makers and players in communities requiring enhanced adaptation and better prevention policies can be found also in other experiences, such as the one reported by Parris (2014) for New York City. Here, after the devastating effects of hurricane Sandy, it became of paramount importance to reverse the usual practice of building back what was lost with no improvement and vulnerability reduction. Also in New York a committee was established by the Mayor, but apparently with a larger and clearer mandate with respect to the previous example of
Goteborg. The committee actually provided the occasion to create shortcuts between researchers, practitioners, decision makers, representatives of different agencies. The positive working environment that was created through the committee lead to the decision and the implementation of repairs, defenses and retrofitting that take into consideration not only the last event (Sandy) but also the forecasted increase of tidal waves and winds due to the potential future forecasted effect of climate change on this type of meteorologically originated hazards.

3.5 Managing ignorance in the disaster risk reduction and climate change adaptation arena: challenges and complexities

3.5.1 Defining and identifying ignorance

Even though not so common in the KM literature, it seems rather evident that in the risk domain in particular, one should not limit the attention to knowledge but consider equally important also the management of ignorance. It is not just a matter of recognizing ignorance areas, but also of understanding how such ignorance is actually affecting the capacity to reduce damages provoked by disasters and to perform during a crisis and afterward. It is not just a matter of uncertainties, but of wider areas of epistemic lack of understanding of sometimes crucial hazards’ mechanisms and/or forms of vulnerability. There are some areas of ignorance that are widely recognized and where therefore investigation and research efforts are invested; others are beyond our capacity to identify, in such case we cannot be aware of their existence; others may have been highlighted by some actors but not considered relevant enough to mobilize research investment.

Rescher (2007) in his remarkable book identifies four ignorance sources that are all relevant for our discussion here: unavailable future, statistical “fog”, intrinsically stochastic nature of some phenomena, lost past.

As for the first type, it is well understood in the risk domain as the impossibility/large uncertainties in predicting extreme events is limiting our capacity to react, for example evacuating, advising people to shelter or avoid transportation means, etc. However the difficulty in making scenarios of the future is evident also with respect to the resistance to foresee the most likely behavior of exposed systems when stressed by hazard events. Linked to the unavailability of the future is also the “unavailability” of the past as far as we miss crucial factors and information of what occurred and how it occurred in historic or prehistoric times. There are many unknown facts of the past that relate to the evolution of the human being, to the agricultural revolution, to the beginning of writing etc. that remain such until new clues and new data are discovered, not differently from what occurs in physics or astronomy.

The statistical “fog” relates to how data regarding large mass phenomena or historic series related to given events such as earthquakes or floods are available to us. Our capacity to data statistically and to make probabilistic assessments permit to indicate general trends, identify averages and deviations, most likely conditions in a large number of cases. The behavior of the entire set, of percentages or parts of the set can be known, however what is impossible to depict is the behavior or the condition of an individual element of the set.

Following the example provided by the Author, one may say that thanks to a mitigation measure that has been taken let’s say in a flood prone area, a very high percentage of the population was alerted and saved; however it is hard to know who exactly was saved, to get to know the individual instances of such percentage.
Somehow we may say that statistical and individual knowledge are mutually exclusive: one may get to know the behavior of a large number of people or a large set of data by applying statistical and probabilistic analysis but the condition of all the individuals in the set is unachievable. On the contrary, one may carry out a very detailed analysis of the specific features of individuals in a set or a group, but then generalizing to a very large number becomes either too expensive or actually impossible because the specificities of individuals overshadow the common characteristics that can be generalized.

On the basis of this mutual divergence, Ginzburg (1980) actually distinguishes between “natural” and social sciences: the first interested in global laws the second looking at individual characteristics at specificities that signal departure or coherence with a general pattern. The statistical “fog” as a condition of ignorance is related to the intrinsic stochastic nature of some phenomena. In fact, we apply statistical and probabilistic methods to treat stochastic phenomena but we are also aware that uncertainties in making forecasts and predictions may be very high.

3.5.2 Organizational ignorance

The issue of what characterizes organizational ignorance, learning and innovation in the field of crisis and risk management has not been at the centre of research and few articles and books are available on the topic. Yet some interesting elements that are central to the Know-4-drr project can be found and will be shortly discuss hereafter. Gilpin and Murphy (2008) raise the issue of how organizational ignorance constitute a relevant obstacle to successful crisis management. They are not focusing on individuals’ ignorance but rather at ignorance that makes a difference at the organizational level, that characterizes organizations as a whole. In particular they suggest four forms of organizational ignorance are particularly deleterious in creating large failures and bad performance: pluralistic, populist, probabilistic, and pragmatic.

Populist ignorance refers to the fact that rumors often unduly condition organizational response in crisis, as the appalling example of the media influencing for the bad the response to Hurricane Katrina in New Orleans.

The other three types of ignorance deserve to be considered more in depth.

The term pluralistic ignorance refers to the condition in which several persons in the organization realize given practices, given conditions, given procedures are either not working properly or even wrong and dangerous, but they do not cry up in the false presumption that nobody else thinks the same. Therefore wrong practices or activities continue to be adopted in the general ignorance of what individuals in the organization have understood but are not sharing neither among people with the same opinion nor with the others until such mistakes provoke a severe accident or failure.

Probabilistic ignorance refers to the condition when information is inaccurate or incomplete, therefore not permitting to reconstruct the entire picture of a situation so as to make the “right” decisions. Interestingly, the Authors indicate the main feature of this type of ignorance not so much as an exclusive lack of information, but also as incapacity to get clues from the situation, to be able identify specific elements in a long series of data that would permit to more knowledgeable people and organizations recognize outliers, emerging trends emerging from the “statistical fog” as Rescher labelled it. The inability to recognize a turning point or a specific issue that is able to lead the entire system towards a totally different scenario, unexpected if only the general trend, if only the average
elements are considered, produce the “surprise” effect and the consequent paralysis of decision making. It may be useful to recall here the work by Barry Turner (1978) who brought forward the idea of “incubator” referring to the long time before the actual occurrence of the disasters when all vulnerabilities and mistakes pile up until the creation of the favorable conditions triggered by a hazardous event. Also Perrow (1999 and 2007) aligns with this perspective, showing how latent vulnerabilities in human complex systems create the conditions for a catastrophe.

The last type of ignorance, pragmatic, refers to the condition where mostly inaccurate, unreliable information is available. In this case the quality of the information does not depend so much on the intrinsic variability of phenomena, on the stochastic nature of events where a knowledgeable individuals needs to be able to distinguish relevant and correct information in the “fog”, but depends more on the sources of information or the way information is disseminated in the organization. It is interesting to note that while probabilistic and pragmatic ignorance denote the characteristics of available information, its sources and intrinsic value, pluralistic and populist ignorance relate to how information and knowledge are used and managed within organization.

All four cases, though, point out at the lack of knowledge to guide among data and information, at ignorance as the lack of capacity to judge and make the best use of available information or search for clues and select the most reliable sources when the latter would be available but not that easy to identify.

Rescher’s and Gilpin and Murphy’s definitions of ignorance are all relevant to us in the disaster and climate change field: there are things we do not know in an absolute terms, that we can discover and get to understand by studying, researching and experimenting.

In the more recent years there seems to be a recognition among scientists that we will not be able to solve everything, that there are still areas of relative or absolute ignorance, that such ignorance cannot be simply labelled in terms of “uncertainty” that can be then managed probabilistically. Some areas of ignorance go beyond our capacity to address, at least for now, then with new discoveries, enhanced understanding, better models we will be able to restrict some areas of ignorance that are particularly relevant for us. But as correctly, put by Trench (2008) quoting an article written by Anna Bradly in the Guardian in 2000 regarding the UK government treatment of the BSE, “uncertainty and ignorance are part of the normal spectrum of scientific data”.

3.6 Moving towards more interactive and participatory models of knowledge management

3.6.1 Working at the interface between science and societal needs

In a relevant report developed by the European Commission (2007), reasons for the increasing gap between science and scientists and the so-called “civil society” have been investigated. This report discusses the science/policy/society interfaces that have been increasingly debated in the last decades as testified by various books and articles (Jasanoff, 1990; Funtowicz and Ravetz, 1990). Science and scientists are often at the center of criticism and debate in general as they are fundamental to processes of innovation and competitiveness in our interconnected world of markets and networks. Criticism towards science and scientists have different reasons: from realizing that not all scientific discoveries are for the good of humanity, that sometimes fundamental issues are still poorly understood and at
the heart of controversies, that finally not all “science” that is produced, often at public expense, is
that reliable and transparent as it should be, as it is supposed to be.
In the Know-4-ddr project, despite some discussions and also criticisms that were raised by members
of the consortium in various project meetings, “scientists” were identified as a relevant, somehow
“independent” social group whose knowledge contribution to disaster risk reduction and climate
change adaptation is essential, yet not sufficient. Even though it was recognized that “scientists” are
not an independent social group, that can be treated in isolation from the others, it made some sense
to identify “scientific” knowledge as different from “common” knowledge, or to knowledge related
to how things should be done according to procedures in the public sector (public organizations),
according to what legislation, or to methods that are adopted in different branches of the private sector
(from businesses to lifelines managing companies).
Scientific knowledge, that is formalized, shared and recognized as such at least among peers, that is
the result of an explicit effort rationally constructed and meant to increase the knowledge base and to
provide enhanced explications and understandings of the world, is anyhow central to the risk
management debate and is extensively used and sometimes even triggered and solicited by different
societal groups, including public, private bodies and the so called civil society.
This does not necessarily mean that all knowledge that is produced in any scientific field is
immediately useful or usable by society at large. On the contrary, going back to the science/policy
and to the science/society interfaces, the actions and decisions in the risk arena that require scientific
guidance and yet need to be applicable in the real world, in the actual administrative processes and
procedures, need to receive certain types of input, need to rely on certain type of knowledge. The
latter in particular needs to be “usable” and used for those decisions and actions. In this regard, as
suggested by Sarewitz and Pielke (2007), the supply and demand of knowledge so to say need to be
reconciled and meet should fundamental problems, environmental or risk related, be successfully
managed and solved. The Authors suggest that there is no “straightforward model for how knowledge
and application interact; yet one feature that invariably characterizes successful innovation is ongoing
communication between the producers and users of knowledge”. Quoting previous work, the two
Authors note that “very little consideration has been given, however, to science policy – that is, to the
decision processes that strongly determine the priorities, institutional settings, and metrics of success
for the supply of scientific research”. In fact, many times the scientific endeavor is judged according
to values and metrics that are auto-referential, that privileges axes of research that are more rewarding
because they are shared by many peers and excludes instead domains and topics that are new and
therefore inherently more uncertain in their outcomes by making them hard to publish in peer
reviewed journals.

3.6.2 Crossing knowledge boundaries with the help of individuals, organizations, “objects”.

From literature and our own analysis of case studies and of the results of the interaction that took
place in the living labs, it emerged rather clearly that knowledge management may work only within
a community of practice. The idea of a universal “fit for all purposes and all users” knowledge
management model is misplaced and perhaps does not even make sense in a world where both the
quantity and the complexity of what needs to be known has enlarged so much, to unconceivable levels
until just a couple of centuries ago.
By presenting the everyday life and activities of a volunteers community carrying out search and rescue at sea in Norway, Kolbotn (2004) points at the need to balance between the “practice”, that is the standardized ways that proved to work and the “process” of innovating, particularly when creativity and improvisation are required in face of unexpected harsh sea conditions. This balance between the established practice and the process of learning and innovating is by no means banal and requires to be managed by skilled and capable people. Finding the balance is even harder when a large number of organizations are involved, at different scales and with different mandates and competences along the disaster cycle.

As the knowledge and information flow mapping has shown in the twelve case studies that were considered in the Know-4-drr project (see Deliverables 1.2 and 2.2.), interaction between scientists and other social groups occurs on a different ground than publications, mainly when they are consulting on specific decisions, policy processes or events. And the difficulties in communicating between scientists and other stakeholders, the difficulties in overcoming barriers and presenting scientific results in a comprehensible manner, in producing results that are useful for the decisions at stake have been already discussed and are at this stage a rather well recognized problem. The scientific endeavor though is suitable to tackle the types of ignorance defined by Rescher (2009). Nevertheless as we discussed there are other forms of ignorance, in particular organizational, that impede to decide and act in the best way that would be possible for us in the field of natural hazards and environmental changes. Such forms of ignorance relate to how knowledge that is available somewhere, by someone, in different fields of scientific research and practical experience and management, is shared, stored, discussed by those who would most benefit from it. In this case, knowledge management has more to do with bridging and overcoming barriers and creating interfaces of the types described by Carlile (2004).

Risk assessment and management, as well as crisis management, are heavily characterized by boundary conditions, arising at the border of scientific and technical expertise, but also between organisations that are intervening in the various stages of the risk management “cycle”. Different technical and scientific expertise can be found not only in the academic arena, but also among civil protection officials, between seismic and flood experts who need to converge in the preparation, of let’s say, an emergency plan for a municipality or a region. Even though interdisciplinary work has been popular since at least a couple of decades, it is still very often the case that experts with different backgrounds interact very little with one another and are unable to recognise profound similarities as well as true differences in the models and methods they use to assess risk and propose mitigation measures (Eigenbrode et al., 2007; Lélé and Noorgaard, 2005).

Even larger problems arise at the interface among organisations with a mandate in the field of risk assessment, management, adaptation, etc. Some of those organisations are actually interacting on an everyday basis, either for prevention purposes or for emergency management, but some others are not, they meet only very occasionally and sometimes even develop conflicts regarding tasks and roles (Menoni and Pugliano, 2013). Coordination as the wish, before the possibility, to manage the reciprocal dependence of activities and resources, is a key element in risk prevention and management, as increasingly recognised in more recent and more complex disasters. What Carlile (2004) suggests for creating the conditions of effective transfer, translation, and transformation of knowledge across boundaries perfectly fits the disaster risk and climate change adaptation arena.
In this regard more interactive and participatory forms of knowledge management can be enabled by the recourse to individuals, groups that are able to cross boundaries and create links between different people’s and groups’ knowledge and/or by objects, artefacts such as IT system that permit an easy access to information, knowledge and also experts who held required knowledge in a given domain.

Boundaries and interfaces can be satisfactorily managed by “boundary actors”, “boundary organizations”, or by boundary objects. In the first case, there are some actors that behave as facilitators, translators from one domain to another.

In the input paper to GAR 15 by Duncan et al. (2014) it was suggested that such actors can be knowledge brokers or by actors that can act in two or more domains. In the latter case the example of “pracademics” was considered, as scientists or practitioners moving back and forward between academia, research centres and professional work in public administrations or private businesses. Getting experience in different knowledge domains can be certainly very useful to bridge among stakeholders. It should be carefully considered though also the possibility of utilitarian exploitation of different domains for the seek of a career or for escaping from the constraints and the rules in a given domain of practice.

What those examples clearly show is that the traditional dissemination in the form of scientific articles does not work if they ever worked. As discussed previously, scientific articles are searched only by other researchers (mostly from the same field) while other stakeholders groups will read an article only if advised to do so by peers or in personal contacts and discussions where the relevance of that particular article has emerged.

Boundary objects are instead occasions, situational contexts in which knowledge sharing, translation, and transformation may occur more easily thanks to a specific mandate or to a common task.

However, such boundary agents and/or objects may work only at some conditions. First that they produce or make available knowledge that is useful to all the parties they serve, second that the latter are somehow “ready” “capable” of making the best use of this knowledge, embed it in their own processes and transform it into something they held and are able to use to make decisions and act. In this respect the work by Lagadec (1995) and Roux Dufort (2000) is particularly relevant, as they suggest only some types of organizations are actually able to learn and therefore also acquire new knowledge. Their considerations go to organizations dealing with crises, as they suggest that only partially prepared or well-prepared organizations are able to actually learn from failures for example, while non-prepared ones are unable to do so. We think that their considerations apply to a very wide range of organizations, not only to those dealing with emergencies.

In order to learn an organization needs to have put in place mechanism, capacities, and conditions that permit learning and reflecting about practices, processes and individual aspects of what they know and do. Learning from failure is one important field that has been investigated for long time by organizational scientists (Fortune and Peters, 1995; Roux Dufort, 2000) and has been considered as an important feature of resilience (Longstaff, 2010). Being able to analyze errors and mistakes and evolve towards more reliable and functional settings is essential as in highly uncertain and dynamically changing situations as crises are, no person or organization may deem to be invulnerable or infallible. On the other hand, in order to learn from failure, organizations need to possess already knowledge regarding at least how they function, and what are the conditions and forms of learning that may be more effective for them. In other words they need to have developed a knowledge
management method that is not necessarily computer based, but works to elaborate on what and why went wrong (and well) in a given event, to make this understanding a common resource for all those pertaining to the organization, and to translate what has been learned into decisions and acts.

Thus we in particular wish to focus here on the use and design of “boundary objects” helping stakeholders to cross boundaries, to transform them into effective interfaces that lead to collaboration in dealing with very complex issues that are increasingly typical of disaster risk management today. Two types of “boundary objects” or “boundary experiences” will be discussed here: the first relates to participatory activities that were conducted in two workshops organised within the Know-4-drr project, the second related to living labs. “Boundary objects” have been already identified in literature as key to produce “salient” knowledge (Cash et al., 2003), as experts from different fields, practitioners and scientists, decision makers and hardware and software developers are working together to find solutions rather than working separately. Creating a common understanding and a common framing of problems sets the floor for finding solutions that are more likely to be implemented. Also, at the interface between disciplines, between practice and theory, innovation is more likely to occur, as consolidated knowledge within each field, each expertise, each sector is somehow hampering the introduction of new solutions, of new views of problems, which require as suggested by Carlile (2004) “knowledge transformation” that does not come without a cost. Innovative solutions require as a pre-condition the re-framing of problems, viewing them under new light, which in turn must be based on both experience, as a background knowledge against which innovation and learning capacity can be tested.

Without learning, without continuous knowledge enhancement there can be no innovation enhancement (Zeleny, 2006). Innovating in all aspects relevant for risk management, to introduction of new technologies, to procedures and strategies implies inevitably hard work at the boundary between organisations and institutions, creating opportunities for knowledge and new interpretations and understanding to flow so to say among individuals and groups across all sectors that have been identified in the Know-4-drr project.

3.6.3 Examples of boundary objects in the Know-4-drr project

The participatory workshops that have been described in section 3.6.2., referring to the flood simulation game in Rotterdam and the flood scenario on the Elbe River basin in 2013 were appreciated by participants and proved to be a relevant interactive occasion of working together and confronting knowledge and ideas about the best mitigation solutions given certain constraints that are somehow common in the life of at least some of the stakeholders. Both experiences provided the opportunity to reflect on mitigation and on relevant real life constraints at, so to say, a “higher” and “deeper” level than would be allowed in ordinary discussions after a conference presentation. In fact, in both experiences there was something at stake for participants who had to exchange with others opinions, positions, beliefs and constraints.

Certainly the diversity of countries from which stakeholders came added to the exercise and game that were proposed, as, apart from organisational and cultural differences, other dimensions of culture, linked to the country of origin and to the way emergencies and risks are managed in each country, emerged and provided an interesting point for sharing experiences and discussion.
A living lab is a conceptual research and development approach. The term living lab was developed in computer science in the 1980’s. It was promptly adopted in human-computer interaction and participatory design. Most of existing Living Labs deal with new technologies in everyday contexts as used by people to achieve their goals; they are interaction systems where innovation takes place in real life contexts through knowledge sharing, collaboration and experiments in open environments. In these contexts, people from different areas of life explore innovative tools by interacting with them and discovering new ideas to expand their knowledge and to explore ways of acting (Følstad, 2008). Boronowsky, Herzog, Knackfüb, and Lawo (2006) see the Living Lab as a setting of shared resources focussed on finding responses to problems and helping one another to achieve their goals. In these environments expert knowledge is involved but is not the unique or the most important knowledge; it plays a role in a way that does not follow consultancy-like mechanisms.

A living lab, in fact, is where knowledge workers are enabled to perform knowledge work in productive way thus contributing to collective intelligence by supporting core experimental capability and shared understanding. In Living Labs learning and knowledge creation happens within complexity. Four living labs (see Deliverable 3.3) have been developed in the project: in Vietnam, in Spain (Lorca), two in Italy (Po River basin and Umbria Region).

3.6.4 Finding new ways to communicate between scientists and the non-expert public: creating connections between scientific and “common” knowledge

The experience that we have carried out with a professional editor expert in scientific communication particularly in the development of videos, WebTV, radio and TV casts provided us with important insights and for us as researchers and practitioners in the DRR and CCA field, new thoughts about what communication with the large public actually means or better with publics that are non-expert ones.

As will be better explained in the development of a knowledge (see chapter 7 of this deliverable) kit for the production of enhanced media products to communicate about risks and especially mitigation and adaptation options, the main lesson that has been learnt in the course of the Know-4-drr project is that also scientists need to develop a new competence in the field of communication. They need to better understand the difference between the media they may use or required to participate to, they need also to understand the challenges implied in “translating” complex and difficult concepts using stories and metaphors.

The idea that scientists need to “simplify” scientific knowledge is misplaced and too banal: what is required instead is a much deeper understanding of the audience one may get in different media, and particularly the context of the communication. If a disaster with thousands fatalities has just occurred, one cannot talk about resilience, as the issue is how to survive, how to manage the situation and perhaps provide some visions about a better reconstruction. Concepts such as resilience, mitigation, prevention should be introduced and discussed in the so called “peace time”, when there is no “urgent knowledge and information demand” that has to be satisfied.

We found a strong convergence with what has been suggested by Nisbet and Scheufele (2009) in an article titled “What’s next for science communication”, where they address inter alia also the topic of climate change. The Authors suggest that as scientists have gained a high reputation in terms of trustability and credibility the challenge is “to understand how to use this capital to sponsor dialogue, invite differing perspectives, facilitate public participation, reach consensus when appropriate, learn
from disagreement, and avoid common communication mistakes that undermine these goals”. Similarly to the practice we developed with the professional media, that prompted us to use keywords and metaphors to structure our discourse, the Authors suggest the relevance of the use of appropriate “frames”. “At a psychological level, a message frame is only effective if it is relevant, or ‘applicable’ – to a specific, existing interpretative schema acquired through socialization processes or other types of social learning. Successful framing suggests a linkage between two concepts of things, such that, after exposure to a message, audience now accept that they are interconnected”. In fact the article goes on describing a situation that is well known to social scientists working in the disaster and risk fields: conflicts and controversies often, if not always, build on incompatible or simply different frames that shape the concepts and the context in a way that is makes the issue at stake look very different and from completely different angles to the two (or more) parties in the debate. We think that our own experience in the Know-4-drr project, the article quoted above as well as other contributions (see for example Trench, 2008) represent a new starting point for shifting from an approach according to which the public has to “be informed” to one in which an exchange and sharing of knowledge is pursued.
PART II Knowledge management enablers

4 Requirements to develop a Knowledge Management System in the DRR and CCA arena

4.1. Relevant examples of already available KMS in DRR and CCA

Before designing the framework of a KMS it makes sense to look at already available examples. There are not many examples of KMS in the public sector that we were able to analyze and even less in the risk management domain.

The KMS that was developed in the years 2005-2008 for UNFPD and described by Butler et al (2005) is considered as a very relevant and interesting initiative we wish to propose as a reference also for the KMS framework of the know-4-drr project. The developers (see Butler et al., 2008) have stressed very well the significant differences between working for a public rather than a private body. Their experience, though, is limited to one individual organization, whilst in the case of the Know-4-drr project we need to address the “multiorganisation” (Menoni and Pugliano, 2013) that is dealing with risks. The same UNFPD example proved to be very effective but also short in lifetime, as we were not able to find any trace of the KMS that was developed in the current site of the organization, meaning that by changing internal governance also the tool has been abandoned. Sure Butler et al. (2005) stressed the strong commitment that was granted to knowledge exchange, sharing and storing, within the organization at the time when the system was designed. However, because KMS are strongly associated to a community of practice, whenever people in the administration of the agency change, whenever the objectives of the latter are reset, the utility of the system may diminish or even totally vanish.

However, it is also true that as available examples of KMS in the public sector domain remain very few and recent. These examples should be considered as pilots towards a perhaps more stable version that we will be able to create at a later stage after having tested what works and what does not in the first experimental versions.

In boxes 2 to 6 the following KMS have been examined: the PreventionWeb portal developed by ISDR and recently redesigned so as to support the new Sendai Framework for DRR, the Inform platform developed by the JRC aimed at providing open source information and knowledge for risk assessment for humanitarian crisis and disasters, the UN Spider knowledge portal on the use of satellite data for disaster management, the WeAdapt portal more focused on CCA, and the National Observatory (ONRN) developed in France thanks to a joint initiative between the French State (through the Ministry of Environment), the Reinsurance Fund by the French Treasury and the association of French Insurance Industries.

The ONRN and the Inform platforms are somehow similar in their purpose of providing information and knowledge to carry out risk assessment in different regions so as to support decision making at all levels, ranging from communities preparedness to land use and spatial planning. Both platforms provide relevant information and risk profiles, though it is clear that the French case rely on data that was collected at a very detailed scale after each event in particular by insurance companies. Further, the ONRN allows also to navigate maps representing the risk situation of different French regions (Departments). In other words it allows a more in depth and individual navigation through the data and also to carry out some operations on data to get different sets of information regarding the risk situation in a given area.
**BOX 2**

**Title of KMS: PREVENTION WEB – Serving the information needs of the disaster risk reduction community**

UNISDR, http://www.preventionweb.net/

PreventionWeb.net is a participatory web platform for the disaster risk reduction community. The portal aims to facilitate an understanding of the subject of disaster risk reduction (DRR). Besides, it provides information on the work of professionals in the disaster risk reduction area by providing current news and views on the topic, and tools for exchange and collaboration.

The scope of the platform is global. The platform’s outcomes are both academic and technical reports, news, information on current tools, reports, videos, photos and also a job application portal.

Shortly PREVENTION WEB is

- A platform that addresses you towards relevant documents and publications in the domain;
- A platform, providing room for sharing opinions and exchange ideas among users (a sort of virtual discussion room, a wiki, a blog);
- A platform that provides different tools to be used: risk assessment models, vulnerability assessment indicators, etc.

**BOX 3**

**Title of the KMS: INFORM**

JRC – Institute for the Protection and Security of the Citizens
http://www.inform-index.org/

The INFORM was initiated in 2012 by a group including UN agencies, donors, NGOs and research institutions. The overall aim was to establish a common evidence-base for global humanitarian risk analysis.

Information index aims to identify information on the countries that are at risk for a need of humanitarian assistance in response to humanitarian crises. Besides, it aims to assess the underlying factors that may lead to humanitarian crisis requiring humanitarian assistance. At the same time, it aims to track the changes in the country’s risk in the course of the time.

“The INFORM model is based on risk concepts published in scientific literature and envisages three dimensions of risk: Hazards & Exposure, Vulnerability and Lack of Coping Capacity. The INFORM model is split into different levels to provide a quick overview of the underlying factors leading to humanitarian risk. The INFORM index supports a proactive crisis and disaster management framework. It will be helpful for an objective allocation of resources for disaster management as well as for coordinated actions focused on anticipating, mitigating, and preparing for humanitarian emergencies.” (Tom de Grove et al. 2014)

The scope of the platform is global, but the data is collected in the national scale including 191 countries. The platform’s outcomes are maps and national reports.

Shortly INFORM is

- A platform that provides different tools to be used: risk assessment models, vulnerability assessment indicators, etc.
- Mainly an intelligent information system
Box 4
Title of the KMS: UN-SPIDER Knowledge portal
Agency responsible for the KMS: UNOOSA / UN-SPIDER
Date of creation: 2008
In its resolution 61/110 of 14 December 2006 the United Nations General Assembly agreed to establish the "United Nations Platform for Space-based Information for Disaster Management and Emergency Response - UN-SPIDER" as a new United Nations programme, with the following mission statement: "Ensure that all countries and international and regional organizations have access to and develop the capacity to use all types of space-based information to support the full disaster management cycle".
The UN-SPIDER programme is achieving this by focusing on being a gateway to space information for disaster management support, by serving as a bridge to connect the disaster management, risk management and space communities and by being a facilitator of capacity-building and institutional strengthening, in particular for developing countries.
There are two expected user groups:
1. stakeholders in the domain of disaster risk reduction and emergency response (e.g. civil protection agencies, decision makers, etc.)
2. stakeholders in the space domain (Earth Observation, Satellite navigation, Satellite communication)
   --> The Knowledge Portal serves as a platform for both communities. The guiding questions on the homepage are tailored to the information need of the different user groups:
   • How can space technology be applied in case of disaster and risk management?
   • Where can I access satellite data, products and other resources?
   • Who are the users of space technology in disaster and risk management?
   • Which services can UN-SPIDER offer to Member States?
The scope of the KMS is to provide information on satellite data for communication, navigation and earth observation for all phases of the disaster management cycle
The typology of UN-SPIDER is:
- A sort of e-learning platform;
- A platform that addresses you towards relevant documents and publications in the domain;
- A platform providing room for sharing opinions and exchange ideas among users (a sort of virtual discussion room, a wiki, a blog);
- A platform that provides different tools to be used: risk assessment models, vulnerability assessment indicators, etc.
- Mainly an intelligent information system
The outcomes of the KMS are material for self-education and training measures, access to data, software, methods and institutional frameworks.

Box 5
Title of the KMS: weADAPT
Agency responsible for the KMS: Stockholm Environment Institute
Date of creation: 2007 - wikiAdapt 2011 - weADAPT in its current form
weADAPT is an online 'open space' on climate adaptation issues (including the synergies between adaptation and mitigation) which allows practitioners, researchers and policy makers to access credible, high quality information and to share experiences and lessons learnt with the weADAPT community. It is designed to facilitate learning, exchange, collaboration and knowledge integration to build a professional community of research and practice on adaptation issues while developing policy-relevant tools and guidance for adaptation planning and decision-making. Practitioners, researchers, students, adaptation planners and policy makers are the expected users of the platform. The outcomes of the KMS are ideally, improvements in adaptation planning, research and practice and there are some emerging 'stories of impact' to demonstrate where this is happening.
weADAPT is:
- A sort of e-learning platform;
- A platform that addresses you towards relevant documents and publications in the domain;
- A platform providing room for sharing opinions and exchange ideas among users (a sort of virtual discussion room, a wiki, a blog);
- A platform that provides different tools to be used: risk assessment models, vulnerability assessment indicators, etc.
- Mainly an intelligent information system e.g. through our use of semantic tagging
BOX 6

Title of the KMS: ONRN (Observatoire National des Risques Naturels, National Observatory for Natural Risks)

There are initially 3 partners linked through a core partnership agreement:
- French State, represented by Ministry of Ecology and Sustainable Development, Directorate General for Major Risks Management (MEDDE/DGPR),
- CCR, French State Reinsurer of NatCat insurance scheme
- MRN (Mission des risques naturels, Paris, France), an association between the two insurance undertakings trade associations: FFSA and GEMA

Further “project partners” have joined the core partnership, to expand the experiment of an IKMS (information and knowledge management system) network with other agencies interacting under a subsidiarity principle, such as, so far (May 2015):
- EPTB Seine Grands Lacs, as project leader of PAPI « Seine et Marne Franciliennes »
- Institut d’Aménagement et d’Urbanisme de la région Ile de France (IAU Idf)
- Observatoire Régional des Risques Majeurs en région Provence Alpes côte d’Azur (ORRM-PACA)

It has been created in May 2012. The purpose of the KMS is to improve existing information and knowledge on disasters and on risk prevention while creating a multi-stakeholder platform. It allows crisscrossing data and information coming from various stakeholders, providing new knowledge and assessments on areas most risk prone.

Every stakeholder as the platform is on free access on internet at the site: http://www.onrn.fr

The ONRN end users committee, managed by the French National DRR Platform (AFPCN) identifies 10 main end users categories, with professional or associative interests/needs, different from the general public.
At first the IKMS mainly targets these professional users, rather than the general public. All professional users are expected to use the information and data provided by ONRN in their teaching / designing / decision making support/servicing activities towards the general public.

It has been developed from a partnership between insurance companies and the French state, yet it includes now information and data coming from more than a hundred of various institutions contributing to risk management and assessment in France. It is also implemented through experiments with project partners on different specific topics (loss data collection, recording and sharing, lessons learnt, event cumulated losses data bases, using data sharing procedures in studies focused on specific hazard impacts such as floods, implementation of new IKMS platforms in relation to territorial DRR projects such as PAPI…

The typology of KMS is:
- A sort of e-learning platform; It could be used as such by the different end users categories, it’s something to be developed in the years to come.
- A platform that addresses you towards relevant documents and publications in the domain; This is the case.
- A platform providing room for sharing opinions and exchange ideas among users (a sort of virtual discussion room, a wiki, a blog); It could offer already a possibility for the user to ask questions to the webmaster, but it is not planned to become a virtual discussion room. The end user committee in various formats (restricted, working groups, open forum) is in charge of managing the opinion sharing activities. This use of the IKMS will be developed in the years to come.
- A platform that provides different tools to be used: risk assessment models, vulnerability assessment indicators, etc. Such is clearly and basically the case here, to a certain extent, providing for instance average loss data per asset unit at municipality grid, for each main damaging hazard category (flood, subsidence, etc).
- Mainly an intelligent information system. As it crisscrosses data and information and allows assessing areas at risk, creating new knowledge potentially to be discussed by various other stakeholders, it may meet the criteria for an “intelligent information system”.

stakesholders at municipal scale.
The Inform platform in its turn is open to external users to provide new data and enlarge the knowledge base through an active participation to the system. Both platforms provide access to publications and relevant documents.

The PreventionWeb is a portal that gives access to a very large number of documents and provide links to other relevant sites in the DRR field. More than 17,000 documents have been collected and posted. They can be searched through the Inverse Document Frequency, introduced in information science in 1972, permitting to count how many times each term or two terms are reported in the documents. With respect to the previous version, this PreventionWeb portal looks certainly much more operational and interactive.

4.2 Key requirements for a KMS for DRR in integration to CCA

A new KMS could therefore perform an important task of consolidation and stabilization of knowledge within a given agency or branch of the public administration dealing with risks.

Also, another aspect that was highlighted is the importance of relying on open source instruments that do not require a fee to be used and that can be modified and adjusted to users’ needs. In addition, we have to consider only that part of DRR knowledge that is managed by open data policies (Gurstein, 2011) and accessible because stored in the internet or open to consultation in libraries and public administrations.

Examining the different solutions that have been developed insofar, we think that we can elicit a list of basic findings that should guide anyone wishing to develop a KMS, particularly in the field of disaster risk reduction and climate change adaptation. It does not make sense to develop a general KMS in the field of DRR fit for all purposes or all objectives within the risk governance area. Such a platform would be at best a collection of documents, publications and a list of useful links related to sites that provide more specific aspects, information, topics. PreventionWeb is certainly a very well designed platform in this regard and it would require a lot of effort, design capacity and also outreach to develop something better for a general community of professionals and scientists interested in the wider domain of risk.

What we have discovered is needed and asked for particularly by professionals dealing with crisis management is an easy access to documents, maps, but also knowledge about how to carry out certain activities, that is provided in a unique portal that permits an easy navigation through such mostly needed documents, maps and knowledge about specific aspects of the work to be carried out.

What is considered here therefore is not a generic portal with all available information and knowledge in the domain but one designed to serve given purposes, given “parts” of the overall risk management process. This leads us to the following point. A useful KMS serves a community of practice, that is a group of researchers, professionals, members of public administrations and private companies who share some responsibilities in the risk management process, for example in the domain of building construction or in the domain of post-disaster damage assessment. The community of practice is not made by people with a unique and common disciplinary background, but on the opposite by different expertise and different perspectives, who nevertheless share a common goal or common goals for a given set of activities. In this regard, a KMS would be useful to provide guidance towards a set of documents, information, description of activities, room for exchanging experiences and ideas that are aimed at serving the activities of the community of practice as defined by Lave and Wenger (1991).
KMS may provide larger or smaller room for ideas and experience exchange, depending on how much the community of practice wishes not only to be able to perform given tasks but also to build on each other’s knowledge so as to promote collective learning and new knowledge production. KMS may be a particularly relevant tool in circumstances where knowledge can be easily lost and forgotten by actors working on DRR and considerably overloaded with new legislation, new inputs from research. Researchers themselves by struggling to innovate all the time easily forget concepts and findings that have been already discussed and discovered long ago as the sometimes illusive search for the new makes it today less appealing to read and quote “old” literature. In the Know-4-drr project we have investigated the impact of the economic and financial crisis on knowledge production, sharing and remembering in countries where the public sector was abruptly shrunk, officials were either redistributed to other functions or pre-pensioned (see Deliverable 2.4 and Figure 3). In those cases, knowledge that they possessed got or risked to be lost and gone with them, something that apparently is occurring even in much richer and apparently better-organized countries like Sweden (see Glaas et al., 2010).

From what we have discussed in part I and in the first paragraph of this second part, a KMS for DRR in integration to CCA should be a system enabling the knowledge exchange, co-production, remembering of different actors working together on given tasks and activities, facilitating the sharing of knowledge and experiences. In crisis time, such sharing occurs very rapidly and needs to be extremely effective, in the prevention time KMS should help actors to elicit what is really relevant for the task that he/she wishes to accomplish. Enablers to provide opportunities and capacities for translating knowledge at the border of disciplines, expertise, to co-create new shared meanings. This is more difficult of course. Enablers to transform/mediate knowledge, to innovate in the field of disaster risk. A KMS should not be only a place/room where to insert information, documents, ideas, but also (mainly?) a place where to listen to the others, where sharing means not only to put together knowledge, ideas, experience, but also listening to what others did, to what went well and what went wrong, to prepare for identifying issues, problems, innovation that may pass unnoticed at the beginning but may become extremely important after a while. The cases described in the two books “Late Lessons from Early Warning” by the EEA (2010) represent exactly the lack of capacity to listen, to notice warnings and signals of change that required the capacity to detect them before the problems or issues they provide an alert for become too big to be tackled appropriately or at too high costs.

According to what has described above, a knowledge management system in the disaster risk reduction field should respond to the following requirements:
- To provide orientation through the resources, documents available in a given platform;
- To provide guidance and access to relevant databases and repositories for the task(s) at stake;
- To provide guidance and access to results of past projects (both research and practice);
- To provide guidance through bibliography, like an ancient good librarian;
- To provide guidance and access to relevant case studies, practices (best/worse) and solutions that have been identified until today and that may be of use Social media (virtual space for sharing, learning, co-creating).
- To create virtual spaces for meeting/exchanging information, knowledge, and ideas.
- To “listen”, to acquire what the external “world”, external to the community of practice that developed the framework thinks of what has been proposed.
- To provide a space to “learn”, without having necessarily to be accompanied by someone to navigate in the search of documents, as would be the case for example with PeventionWeb. In the latter case in fact one has to know already what to look for, as a completely “free search” would be in many cases very time consuming and not always effective.
- A knowledge management system that bridges between knowledge on CCA and DRR.

Figure 3. Requirements for a KMS to support DRR and CCA in times of financial crisis
4.3 Proposal of the KMS framework of the Know-4-drr project

What we have described until now, the way we have framed the problem of creating a KMS leads rather naturally to the solution that we are going to propose, which we are fully aware is not “the solution”, but one solution that seem to respond to several needs and requirements that we have encountered in the two years of the project. Traditional knowledge management systems usually permit to organize and share knowledge but we consider this architecture not sufficient for transforming knowledge into wisdom and action; for us it is compulsory to participate into a collective learning/teaching/transmitting KW space in order to reach these goals.

In our perspective, one of the main assumptions is the idea of safety and disaster risk reduction as a public good, which entails the idea of collective, cooperation and co-production of KWDRR in an open environment: an open space where open sources find a variety of market actors who have open access to knowledge assets.

We imagine knowledge building, transmission and co-production in a common area, a multidisciplinary and multiscale space of interaction, built according to the approaches of sharing economy, collective economy and smart environments (Botsman and Rogers, 2010). In sharing and collective economy, the core dynamics are not anymore based on competition and ownership of production resources and production means but on usership and cooperation. The maximization of the productivity of the resources in the system is possible because the sharing of resources reduces duplication in use and consumptions. It is therefore possible to reach optimization at the whole system’s level as all actors contribute, in a collective action perspective, to obtain the best possible results putting together not only material production means (hardware) but also intelligence, smart technology and innovation (software). The exchange of goods and services is then activated in marketplaces characterized by the search for the maximum possible overall utility coming from the assets and not anymore on their exclusive possession. This may also solve the problem of the governance and management of public goods and the commons, at least where uses are compatible with availability and the regeneration capability.

The KMS has therefore been imagined as a space where we find subjects producing, diffusing and using knowledge, interacting with each other exchanging knowledge assets and placing themselves in an exchange space according to cyclic chains of production-supply-demand for knowledge, like in a marketplace. The whole of the exchanges produces flows of values which, due to the nature of KWDRR as a public good, are embodied in the expected enhancement of DRR action at all scales and in the associated reduction of damage incidence on local communities. Moreover, values may be recognized in the increased capability to build new collective knowledge as the result of a dynamic network of exchange interactions.

Given what has been said above about communities of practice, it is evident how important it is to envisage a space, also a virtual one, where to overcome fragmentation and enable communication among knowledge stakeholders, activating participation and fruitful exchange. This is why the focus of our research has been the search for a common multiscale space of interaction, where to place knowledge categories, assets and stakeholders. Accordingly, the building of a space to enable and improve the production of collective knowledge for disaster prevention by way of knowledge exchanges becomes central. We need to produce “new collective knowledge” as the capitalization of the already huge amount of knowledge available in different shapes and contents in the system by
way of sharing and collective use, so to optimize the knowledge assets use. We then refer to a capitalization process as in an economic perspective, where action is expected to enhance and increase the capital itself of available knowledge and to maximize the value flows coming from it. Moreover, we have to persuade stakeholders in the private sector and in the civil society to invest resources and, possibly, change their attitudes towards prevention: how to encourage them to interact and exchange knowledge?

Finally, we made reference to the approaches of the knowledge network theory, which point out the crucial importance of the management of knowledge looking at different stakeholders across organizational borders as a mean of active involvement in knowledge use optimization, cross-fertilization and innovation (Mentzas et al. 2006, Carlile 2004). The main difference found in the DRR application is the absence of property rights on knowledge production and on the processes that enable knowledge flows. We therefore identify a public space where we find subjects producing, transmitting and using knowledge in an open source perspective. They continuously interact with each other in a dynamic environment, exchanging and matching knowledge embedded in knowledge assets. We refer to a not-hierarchical system of stakeholders acting as producers, suppliers and customers of knowledge contents that are essentially existing but need to be differently organized in new KWDRR assets and made available to different users.

The public space is therefore represented as a marketplace, borrowing the main meaning of market from economy. A space hosting the exchanges, where the solution of the dynamics among producers, suppliers and demanders obtain the optimal allocation of resources and the best possible results, measured as the maximization of value added and systems’ utility.

Moreover, a space where innovative demand may emerge as the result of the exchanges and mutual contamination of market’s community, as in all markets, but here enhanced by the nature of KWDRR as a public good, which means interactions not based on competition but on cooperation and partnership. Then, new KWDRR contents emerge, assuming different shapes in a variety of knowledge assets and enabling tools.

The novelty of our proposal here regards the transition from individual knowledge production to collective knowledge production by the adoption of the concept of collective intellect as defined by Lévy (Lévy, 1997). The proposed DRR marketplace is an arena where the stakeholders are called and enabled to “coproduce, develop, and continuously modify the virtual world that expresses their community” by developing a contextualized collective knowledge. The participants to the DRR marketplace are continuously, by their knowledge production, supplying and consumption, learning and in the same time inventing.

In our knowledge marketplace, knowledge is not seen as an object that can be stored, transmitted and transformed independently from the processes of its creation and application, but as a resource intimately related to the way and the context in which it is used (Lytras, 2009).

Given the marketplace metaphor, the following questions need to be answered:

a. How to produce “new collective knowledge” capitalizing on the already very large knowledge available in different shapes and contents in the system?

b. How to persuade society to invest resources in prevention?

c. How to encourage different stakeholders to interact and exchange knowledge also in time of peace, when there is no strong motivation as in crisis?
A first model for the marketplace emerged and is represented in Figure 4. Spaces for knowledge production, supply and demand can be observed. The spaces are distinguished based on the knowledge assets characterizing it and classified according to different levels of synthesis/analysis, simplification/complexity, and usability/formality. As much the knowledge assets become more synthetic, simple and usable, as much they appear suitable for demand subjects. Producers normally deal with analysis, complexity and formalization, while suppliers are the subjects that process the formal knowledge produced in the system in order to make it available for demanders in the shapes needed to enhance knowledge diffusion and exchange at different territorial and community levels.

![Figure 4. Representation of the knowledge “market”](image)

We assume our marketplace as a non-hierarchical system of stakeholders (see Figure 5) acting as producers, suppliers and customers of knowledge contents that are essentially existing but need to be differently organized in new knowledge for DRR assets (see Figure 6) and made available to different users. The marketplace we envisage capitalizes the available knowledge and makes it operational and usable at all levels, with special attention to public institutions, local communities and the civil society as key demanders for knowledge for DRR Kits, new assets integrating collective knowledge. Moreover, it fosters interactions and exchanges and supports co-production and new knowledge assets as the results of a variety of demand-production-supply chains.

In the marketplace, the nearer the position is to simplification and synthesis, civil society and common knowledge, the more careful the ‘supervision’ of the scientific environment should be, in order to avoid false convictions, stereotypes and excess of simplification.
Figure 5. Representation of the subjects in the knowledge “market”

Figure 6. Knowledge objects in the knowledge for DRR marketplace architecture
It is a space where innovative demand may emerge as the result of the exchanges and mutual contamination of market’s community (see Figure 7), as in all markets, but here enhanced by the nature of knowledge for DRR as a public good, which means interactions not based on competition but on cooperation and partnership.

We imagine the knowledge for DRR marketplace as a catalyzer of knowledge transformation processes, able to offer on a same space, and in shapes allowing for different knowledge needs, a huge variety of knowledge and information pieces coming from many different perspectives and stakeholders acting in facing and coping with disasters. Using a market-like model, it is easier to imagine knowledge assets production and supply according to a complex and dynamic demand and exchange at multi-scale levels and among different stakeholder categories. As a result, it is possible to envisage innovative knowledge assets, like, as an operational example, knowledge for DRR Kits, customized on demand, might it be tangible and existent or a study hypothesis. The marketplace also enhances the idea of interaction and dynamic environment, in which the continuous exchange among demand, supply and production, in a cooperative perspective, fosters innovation and development. This in a cooperative perspective, addressed by the strong common goal of DRR and damage prevention and mitigation, differently from the pure economic rational of competition-driven innovation. A possible solution to reduce, to some extent, fragmentation of knowledge for DRR by way of a flow of knowledge ex-change and the development of knowledge for DRR Kits incorporating “what is needed” as the outcome of collaboration and exchanges among stakeholders. A highly valuable demand-driven innovation, because demanders allocate a great value to knowledge assets that are nearer to their needs and utility. In this perspective we introduce an idea of “Knowledge KITs” very similar to the “knowledge assets” proposed by Butler et al. (2007), that is demand-
oriented packages of knowledge assets and enabling tools (see Figure 8). KITs or Assets will be distinguished according to the main four stakeholder categories in the market - “scientists”, public and private sectors and civil society and to the four knowledge categories introduced in paragraph 2.2 - scientific knowledge, organizational knowledge, regulatory knowledge and common knowledge. Knowledge kits differentiation and quality mainly refers to the degree of analysis and formality or synthesis and simplification crossed with the knowledge stakeholder and the knowledge category. We particularly focus on the ground level, to public institutions, civil society and common knowledge, where the demand for knowledge is a crucial matter in DRR and the need for enhancing usability and learning processes is central.

Figure 8. DRR Knowledge marketplace

PuS KITs= Knowledge Packages customized for Public Sector Subjects
PrS KITs= Knowledge Packages customized for Private Sector Subjects
CS KITs= Knowledge Packages customized for Civil Society Subjects

As far as the marketplace works, the knowledge increases as well, in a kind of an ascending spiral where every knowledge cycle produces an increase in the overall KWDRR, more suitable to reduce change resistance and to enhance DRR. The DRR enhancement resulting from the market functioning is a second value added (the first being the reduction of losses and damages). The maximization of benefits is therefore the accumulation of new DRR collective knowledge, of KWDRR KITs availability and of the overall benefits due to the improvement in DRR results and practices. To synthetize the values at stake, the following may be recognized:

- values incorporated in territorial elements, subjects and objects prone to disasters and their impacts;
• values coming from a tool “able to maximize the value flows and the value added” coming from the better and huger possible use of the existing capital of KWDRR;
• highly valuable demand-driven innovation, because demanders allocate a great value to knowledge assets that are nearer to their needs and utility;
• every knowledge cycle produces an increase in the overall KWDRR, more suitable to reduce change resistance and to enhance DRR. The DRR enhancement resulting from the market functioning is a second value added, the first being the reduction of losses and damages.

A mention is needed to conditions and constraints to market functioning, which, like in economy, must be understood and controlled in order to avoid market failures in producing knowledge development and innovation and in supporting stakeholders interactions, knowledge coproduction and collective knowledge production. These are mainly obstacles and barriers to knowledge exchange flows. Barriers as in the economy understanding (and as in Carlile 2004), which prevent the interactions of stakeholders and the knowledge contamination and reduce the production of new products, value added and positive externalities.

4.4 The knowledge asset for the enhancement of risk assessment procedures to respond to the Flood Directive requirements and to support flood risk management plans.

The Po River basin community of practice is made by two components: one is the core group represented by the Po River Basin Authority and its staff and by a group of researchers of the Politecnico di Milano. Se second group comprises the representatives of different regional and provincial authorities of the administrations that are geographically included in the Po River basin.

Figure 9. Knowledge kit for the Po River Basin community of practice
We need to make this distinction as the core group actually developed the knowledge asset, and the second group provided inputs and ideas but did not contributed to it directly.

The activity had already been started when the Know-4-drr project began, however the continuous participation of the General Secretary of the Po River basin Authority to all the meetings of the project has given a special impulse to the activity and permitted to actually introduce many ideas that were discussed in the project directly into the flood risk management plan as required by the Floods Directive.

The knowledge asset that results from this activity can be seen in Figure 9.

The knowledge asset basically provide one possible methodology to carry out a comprehensive risk assessment to support the flood risk management plan. In the joint activity of the Po River Basin community of practice, it has been conceived as a set of five macro-activities that will be described here below. As in the case of the Umbria living lab, also the minimal level of knowledge required to carry out the activities will be provided.

a. Identify to flood prone areas. Basically this is the identification of the hazard zones that are generally characterized by the expected return period of the flood to which the given flooding zone corresponds to. This is the type of activity that the River Basin authorities in Italy were more familiar with and therefore they already have the expertise for this activity. However, the Flood Directive require now not only the identification of the zones, but also of expected depth, a parameter that is more difficult to obtain particularly over large zones and demands more sophisticated and time-consuming models to be used.

Know what: the identification of the flooding zones is part of the more consolidate knowledge by hydraulic engineers. Certainly the definition of the flood hazard as a whole for a given region requires the integration of different expertises, ranging from meteorology to hydrology to hydraulic engineering. Even though the smooth collaboration among experts of the different fields is still an issue, scientists know at least in principle how the different knowledge segments should be combined to get the entire chain. Also the topic of the different types of floods one may encounter and for which different types of modelling need to be considered, in particular for flash/mountain and riverine floods is well established. Again further improvement is possible, but the essence of what would be needed to carry out an optimal assessment is known.

Know how: different models have been developed until now to assess the various segments necessary for a comprehensive hazard assessment. Experts in the field are able to calibrate the models and adapt them at best to specific geographic contexts. Examples of applications of such models can be provided as well as reference to the most relevant literature in the field.

b. Exposure assessment

Assessment of exposed systems is simple in principle, however several difficulties may be encountered in practice. In theory anything that lays in a hazardous zone is virtually exposed to the flood threat. However when it comes to identify systems and not just individual objects that are located in flood prone areas, things may become more difficult. However the most problematic issue is how to translate exposed elements that are physically located in hazardous zones into economic and then into monetary terms. There are some guidelines that have been elaborated to help in such
translation, however it is not as standardized as the procedures to identify and assess the hazard and hazardous zones.

**Know what:** different competences are needed to define exposed elements and corresponding exposed values. They range from engineering to economy. Insurance providers are certainly very well equipped to assess the value of exposed elements. Also companies working as consultants for the insurance industry, providing damage scenarios to be used to set policies premiums, have the knowledge to estimate the value, the monetary value, of exposed elements.

**Know how:** examples of how to carry out the translation, guidelines to be followed can be shared and constitute an important basis for authorities and agencies in charge of developing risk assessments in the context of the Flood Directive. Certainly the knowledge of post-disaster damage can significantly contribute to enhance the capacity to estimate such values.

c. **Assessing the vulnerability of exposed assets and systems.**
This is the field where less expertise exists. Still with respect to ten years ago significant research has been carried out to develop methodologies and identify indicators to permit carry out vulnerability assessment for various risks and for different exposed elements and systems. The knowledge that has been developed can be found in the deliverables of research projects (for example those funded by the EU such as Move, Embrace, Ensure specifically on vulnerability and resilience or others such as SynerG developed for specific risks. In the case of flood risk, the Floodsite project certainly constitutes one fundamental reference), scientific papers and examples of applications carried out by different administrations. In this case examples can be found in the work of the Arno River basin Authority for cultural heritage in Italy and of the Middle Loire River Basin Authority particularly with respect to the vulnerability of industries.

**Know what:** There is nowadays a certain consensus on what vulnerability means and in particular in the case of flood some indicators have been identified referring to the characteristics of exposed objects to be more or less severely damaged when affected by floods. It is recognized that vulnerability to flash flood is different from that to riverine floods and some indicators can be used to distinguish between the two cases.

**Know how:** as mentioned there are examples that can be found and experts (researchers and officials working in public administrations) who have worked on the topic. Some material for consultation can be found as well in the form of reports, papers, etc.

d. **Damage curves**
Damage curves are the most established tools for transforming a qualitative vulnerability assessment into a quantitative measure of expected damage given one specific feature of the expected flood (water depth). There exist nowadays a consistent literature with several sets of curves developed in different geographic context including Europe. Application to contexts for which the damage curves have not been developed is still an issue, yet researchers are working on collecting better damage data to tailor damage curves to the specific characteristics of assets in different geographic areas.

**Know what:** damage curves have been developed for various types of exposed elements and assets ranging from residential buildings, to industries, to agriculture, to infrastructures. Not all developed curves have the same reliability in terms of statistical consistency. There are also issues of spatial scale when applying such curves to large spatial scales or locally.
Know how: Papers, manuals, and more recently even computer codes have been developed to permit the application of damage curves for estimating ex ante the potential effects of floods in a given area of concern.

e. Assessing expected damage and prioritize mitigation measures.
Once damage curves have been applied to the relevant systems for which they have been developed, one may complement the estimation of expected damage with more qualitative assessment related for example to the interdependency of systems so as to identify potential cascading effects triggered by interconnected objects or systems as well as the amplification of effects across systems such as the economic one. The identification of potential damage, that has been partially monetized through the damage curves may serve as a basis to prioritize intervention and also to carry out cost-benefit analyses of mitigation measures with respect to what can be foreseen as avoided costs due to damage. 

Know what: This set of activities require a large variety of expertise ranging from engineering to economy to computer science. Also it has to be pointed out that the prioritization of measures cannot be grounded only on the results of models and of cost benefit analysis as it implies significant value laden considerations.

Know how: this is a very complex set of activities for which some partial examples exist and can be taken as a reference. The results of the assessments carried out by River Basin Authorities across Europe to implement the Floods Directive certainly constitute a huge repository of knowledge that has been developed by officials together with researchers and practitioners to develop a type of assessment that was unusual for the authorities themselves. A rather wide range of different ways to tackle the issue has been developed by the various authorities and it would be certainly very helpful to be able to consult the methods and the results of the assessment in a common virtual space.
4.5 The Knowledge asset for the post-flood damage assessment, adapted to the Umbria Region

4.5.1 Description of the Umbria Region Civil Protection Community of practice.

A group of researchers of the Politecnico di Milano and the Umbria Region Civil Protection have started a collaboration on flood related topics in 2011. One of the activities was related to develop damage functions for the Umbria Region as part of the implementation of the Flood Directive, that requires an extended risk assessment that goes much beyond hazard to include the exposure of population and the propensity to damage of economic sectors, cultural heritage and the potential Na-techs consequent to inundation of hazardous industrial installations. The joint work evidenced the lack of data necessary to develop damage functions for the Italian context and the need to rethink the way post-flood damage assessment is carried out in the Region and in Italy more broadly.

After the decision, a first draft of forms to carry out direct surveys in flooded areas was developed and tested jointly in June 2012. Since then a number of floods occurred in the Region and impelled the development of a complete procedure, that goes much beyond the collection of data through surveys, to comprehend all sectors that are affected during a flood. Data collection and analysis were carried out in particular after the November 2012, November 2013, February 2014 floods (and landslides occurrences).

The real events made it possible and necessary to activate the civil protection mechanism, including officials of the Umbria Region, of the affected municipalities and a rather large number of volunteers. Even though the procedure was developed jointly by the Civil Protection and the researchers of the Politecnico di Milano, all involved stakeholders participated to different degrees, by the means of interviews, joint meeting, training activities. All stakeholders that participated actively to the post-flood damage assessment data collection and analysis can be therefore considered as the community of practice that provides the fundamental bricks of the knowledge kit and in the meantime may profit and use it for further developments and for applying it in the case of need. In principle such knowledge kit could be useful also for other administrations, regions, countries that are interested in developing practices to collect and analyze post-flood damage data.

The knowledge asset that results from this activity can be seen in Figure 10.

4.5.2 Description of the main activities to be supported by the knowledge asset.

In Figure 7 the set of activities for which different types of knowledge regarding what the activities are about, how they can be carried out, what material and resources are necessary to carry them out are represented in the colored boxes. The arrows allude at the time sequence according to which activities have to be carried out and that will require different knowledge and information as long as the steps of the damage data collection procedure and analysis evolve.

The following activities are envisaged:

a. First the identification and mapping of the flooded zones. This seems an apparently trivial activity, but it actually requires profound knowledge about how the maps can be actually obtained, what are the procedures to acquire satellite data, aerial flights, or the execution of direct surveys by public administration personnels or volunteers.

b. Second, the collection and storing of data that are collected in the form of notifications or aid requests by the civil protection emergency control centre. Such notifications may come from public
utilities providers, from municipalities, from any agency that reports damage that needs to be taken care of. The important point here is the storage of this data so that it will be available after the problems have been solved to carry out deeper analysis.

c. Direct surveys carried out at affected residential, commercial and industrial buildings. To be effective those surveys need to count on prior preparation, such as provision of maps of the areas to be surveyed and forms to be compiled to collect all relevant information.

d. Analysis and organization of data coming from various authorities ranging from municipalities, to utilities providers, to economic sectors associations, who report damage suffered in their territories or by their affiliated. Such damage is generally reported to a variety of organizations and agencies and are very rarely used to compile a comprehensive damage assessment. Yet they are used nowadays in Italy to provide some compensation according to a recovery plan detailed on the basis of the money that is made available for the disaster by national authorities. Such data are also needed to request access to the European Solidarity Fund, in case the latter is applied for.

e. Production of a first report summarizing the severity of the event and the damage that has been surveyed in the days after the event. Such report is generally produced to ask for the state of emergency declaration, to which the possibility to access funding for emergency and recovery is linked.

f. Production of a more advanced and complete damage assessment report. This report should contain a more robust assessment of the damage, carried out sometime after the event so that also indirect and longer-term damage can be estimated. In addition a forensic analysis of the damage should be carried out so as to guide recovery and reconstruction decisions.

Figure 10. Knowledge kit (or asset) for post-flood damage assessment
4.5.3 Description of the knowledge required to carry out the activities.

Each of the activities depicted in Figure 7 and described in 4.3 require specific knowledge to be carried out. It must be noticed that such knowledge is partially available in the research community focusing on the topic, partially in practice that has been developed by various agencies, national as well as international, and partially was developed by testing and doing within the community of practice of the Umbria Region Civil Protection and Polimi researchers.

The knowledge required for each activity is detailed below.

a. Identification and mapping of the flooded zones.
   **Know what:** to carry out this task hydraulic engineering and hydrology are needed to identify the best solution for mapping and carry out the modelling that sometimes need to complement observation. Knowledge in GIS techniques, satellite images interpretation, and aerial photography is also essential to carry out this task. Within the Umbria Region, community of practice a procedure has been developed together with technical volunteers and with the officials in charge of rivers inspection to survey the perimeter of inundated zones after a flood using topographic methods. The different sources of information, from the air and from the ground, and modelling, are complementing each other.
   **Know how:** each technique that has been described above requires knowledge regarding how to carry out the different procedures. The most important know how however relates to the synthesis of the different information so as to obtain at the end an “official” map of the inundated area.

b. Second the collection and storing of data that are collected in the form of notifications or aid requests by the civil protection emergency control centre.

This activity requires the coordination of the operational knowledge of those working in the operational centre and knowing how data are collected and the procedures to respond to help requests on the one hand and information science knowledge to help create the best repository for the coming data and information.

c. Direct surveys carried out at affected residential, commercial and industrial buildings.
   **Know what:** for each category of buildings to be surveyed one needs to know why certain data have to be collected and what is their utility for forensic investigation, compensation purposes etc. Knowledge on damage types on different structural, non-structural and content components of buildings need also to be possessed so as to understand why a certain indicator has been inserted in the survey form.
   **Know how:** the survey is a technique per se that has been tested and experimented since long, there are therefore tips for well-conducted surveys that have to be shared among all those in charge of this task. Having a reference place where to find such knowledge is helpful to carry out quick checks during an emergency or to teach new volunteers or staff that have recently joined.

d. Analysis and organization of data coming from various authorities.
   **Know what:** the list of authorities, utilities providers, agencies and organizations one may need to contact to get data about disaster damage may be large and subject to some changes even within the same territorial context. Also the data providers may change according to specific arrangements that can be context dependent but also derive from specific legislation or ordinances set for one specific event.
   **Know how:** the analysis of data coming from different authorities, sources in different formats are never easy to treat so as to provide a coherent and comprehensive picture of the damage. One may
need knowledge on the better techniques to be used to harmonize data from different sources, but also find references and examples of how this has been successfully done in past experiences in the same community of practice or somewhere else.

e. Production of a first report.
Rapid post-disaster damage assessment is a branch per se, that requires specific techniques and knowledge on how to carry out estimation when the full picture is still not clear.
Know what: a first report can be produced for a variety of purposes that can be made explicit and that may lead to slight differences in the way the report is compiled.
Know how: there are some examples of rapid post event assessments that have been developed worldwide and that can constitute a useful reference (for example the PDNA methodology). Of course, for the community of practice it is fundamental to capitalize on the procedures and the experiences that have been developed in exercises and in real events.
f. Production of a more advanced and complete damage assessment report.
Know what: a more advanced report, and there might be more than one, depending on the time at which it is developed (for example one six months after the event and one year later), requires a much deeper analysis of the damage. A comprehensive overview of physical damage and losses should be provided together with an analysis of the hazard, exposure and vulnerability factors that weighted more on the final loss account. For such an analysis also an understanding of the hazard and risk maps that were available before the event is necessary to assess on the one hand the level and severity of damages that could have been estimated before and on the other the extent to which mitigation measures were actually tailored to that level and severity of risk.
Know how: some examples of how to develop such a comprehensive report are available for example in France and in the UK; within the Umbria Region community of practice a sort of agreed upon flexible index has been developed and constitutes a guidance for such advanced reports.

4.6 **Knowledge KIT for developing locally adapted flood and storm resistant housing in central Vietnam**

Development Workshop began promoting the preventive strengthening of the homes of vulnerable families in Central Vietnam in 1989 and this almost continuous and ongoing process has engaged the participation of many stakeholders, starting from householders and local communities right up to central government. This work promotes the concept and practice of preventive strengthening of houses and small public buildings so that they can resist the impact of frequent typhoons, whirlwinds and floods. It encourages national and local authorities, local builders and families to integrate the key principles of safer construction into both new building and in the retrofitting of existing buildings especially those of the poor and very poor, and as such is a pure example of disaster risk reduction and adaptation to the impact of climate change. This work has been developed in a broad and holistic context of institutional and technical capacity development amongst local authorities (People’s Committees) and government departments, and with the active participation of non-state actors – civil society, families, local social movements (Women’s Unions, etc.) and community builders and community leaders; collaborative work between local authorities (Commune networks) and between Provincial Departments of Construction, private construction technicians, architects and companies has also been a strong feature of the programme.

Additional impulse to the process has been given in December 2013 when, inspired by the DWF publication of the Vietnam” Atlas of house vulnerability and strengthening” (DWF 2011), based on
local practice, the Ministry of Construction recognized that the existing codes for construction in typhoon and flood risk areas were no longer fit for purpose, and requested DW to collaborate and steer the revision of codes for safe housing in central Vietnam. The Knowledge KIT reflects the components and stages in this process and can be seen in fig 11.

4.6.1. Description of the main activities included in the knowledge asset

a) Establish the partnership with provincial and local authorities and their departments of construction

Know what: Although such partnerships have long existed it remains that the provincial departments of construction have focused on formal sector construction requirements and have largely ignored how construction in the informal sector addresses safety. An initial task is to change attitudes about local construction practice, to come to recognize that lessons can be learnt from how households and communities address flood and storm resistant construction, and to develop knowledge about the key points that can ensure building safety in flood and storm risk areas.

Know how: Various information supports are available, such as training materials for builders, awareness raising posters and handouts on the ten key principles of safe construction, and in many provinces since 2011 Provincial Atlas of House vulnerability and strengthening now exist (edited DWF 2011, 2013).

b) Identification of risk areas with specific exposure to floods and/or storms; forensic survey of previous housing damage and repair measures and a sub set, the identification of vulnerable families
**Know what:** Gathering data from local authorities and provincial services so as to map where floor and storm risk exists. Surveys with commune leaders, local builders and families affected by previous damage during disaster events, and assessment of measures that have been applied for repair and recovery. For this, the understanding of the ten key areas of weakness typical in both existing and repaired buildings is essential.

**Know how:** such surveys are invariably carried out in the aftermath of disaster events and for example after Typhoons Wutip and Nari hit central Vietnam in 2013, surveys were conducted at household and commune level to assess both exactly what damage had occurred and why, and to assess how repairs had been carried out, prior to running support and training programmes to increase safety (DWF 2013/14). Surveys have also been carried out to discuss with local materials producers and builders what they consider to be the best local safety measures, for example on how to avoid roofs being blown off.

c) **Evaluation by local technicians of housing practices & solutions, local vulnerabilities and responses, and a subset, surveys of public building vulnerability & safe refuge retrofit potential**

**Know what:** Building on A) and B), analysis of weakness and strengths in different housing types; analysis of shortcomings in reconstruction measures and steps to address these (for example through local training see F); classification of measures in local design to address household priorities such as safe storage of assets for production, household assets, food and grains and livestock (such as first floor stables);

Classification of vulnerability in public buildings in each commune and identification of measures to reduce these; and identification of possibilities for safe refuge creation including retrofitting in collaboration with District and Commune social and technical services.

**Know how:** examples of the analysis of weakness and strengths in buildings are available for many parts of Vietnam; many of these have been done prior to disaster events, in support of promoting preventive strengthening.

d) **Develop safe housing guidelines integrating local needs, capacity and construction practices**

**Know what:** Preparation for and by each provincial department of construction of practical guidelines based on C), in the form of Atlas for Houses vulnerability and strengthening); preparation of training material and programming for commune level builders and local leaders on the risks, causes for failure and measures for strengthening, based on two day training programmes.

**Know how:** examples of Atlas on House vulnerability and strengthening already exist in 11 provinces in Central Vietnam (DWF 2013).

e) **Prepare sustainable public awareness actions using provincial media (radio/TV press) and local animation options (campaigns, theatre, visibility material)**

**Know what:** In collaboration with provincial media, graphic designers, artists and local creative potential (actors, singers, schools); design and prepare materials for public awareness campaigns and provincial and commune levels. Work with provincial media to make clear the objectives and content
of the Knowledge KIT, so that they will correctly and effectively communicate the messages developed in the KIT; in collaboration with the selected Communes and schools, identify participants and then prepare shows and other events at commune and neighborhood level about the risk and the need for Safer Houses, based on simple messages such as ‘take preventive action to protect your home’;

Identify available resources at government level and develop budgets at for fund raising for both awareness raising and training.

**Know how:** in both Vietnam and Myanmar, public awareness materials and campaign programmes have been develop and applied at regional and commune levels (DWF 1989 and onwards).

For example, for resources, communes frequently are able to contribute to retrofitting public facilities; credit for preventive strengthening is available through Banks in the provinces, and through Unions such as the Women’s Union.

f) Use knowledge acquired to support vulnerable families through 2-day builder training in safe construction, access to targeted credit & commune level safe construction advisory services

**Know how:** Implementation of capacity building in each selected commune with local builders and vulnerable families using

**Know how:** Examples of the Knowledge KIT in action are available in Thua Thien Hu, Quang Binh and Quang Tri provinces and in other provinces in Vietnam (DWF 2011-15); and the same Knowledge KIT has been develop in Myanmar (DWF 2008/10) and Indonesia (DWF 2004).

### 4.7 The Knowledge asset for producing communication solutions for DRR and CCA

#### 4.7.1. Description of the Know-4-drr communication community of practice.

The Know-4-drr consortium was comprised by partners with different expertise and also pertaining to different fields. In particular a professional editor of radio and web-TV formats participated as a partner. We can therefore suggest that the consortium has become a sort of laboratory for testing some ideas of how communication of risk prevention concepts and mitigation practices could be developed to fit the needs of different audiences. In fact, the objective of the dissemination part devoted to the development of radio and web-TV based products was not to communicate risk in general terms but to propose a view on risk mitigation and climate change adaptation that is perhaps not so usual in the media. The objective was not to comment events that have just happened, nor to create stories or sensationalism as is unfortunately often the case, but rather to provide a wider public with the results and the ideas that were discussed and searched during the project. Also, a main objective of the communication campaign was to avoid the “solutionism”, that is the contemporary tendency to think there is a solution to any problem, and even that there is a simple solution to any problem, including very complex ones. A fundamental objective of our own experience that we think can be provided in a knowledge kit, refers to the design of media campaign that fully acknowledge the complexity and the inherent uncertainty of several environmental problems and the consequent impossibility to find easy, ready-made, good for all solutions (Figure 12). A number of products were produced following this philosophy as described in deliverable 3.5.
Also, the editor partner was actively involved in the simulation exercise of the Elbe flood that was carried out in the Bonn Workshop. In the Workshop the main differences of operating in a national or local media, on a radio or in the internet were developed and discussed with the partners and the stakeholders who participated to the meeting. One of the fundamental messages regarded the role of scientists in the new configuration of media including more traditional and newer ones. What is evident in fact, is that new media are not substituting the old ones, but each finds a niche of activity and fields that are more suitable for it narrative timelines and for its potentialities in terms of tools, outreach etc. In this new configuration it is suggested that scientists have a new responsibility that is learning to better communicate science to the public. Of course more journalists with the professional capacity and understanding about science topic will be welcome but it cannot substitute for the often-poor communication competence of scientists.

In the final conference the activities of communication carried out by the professional editor jointly with other project’s partners were presented and compared to the results of the competition the BBC has launched for the Sendai World Conference. In organizing the conference we looked for other editors that were developing products and work similar to the one we had done in the Know-4-drr project, but, apart from the BBC initiative we could not find much. It is therefore a new field of expertise and work that deserves to be explored and for which we deem it would be extremely useful to develop a knowledge asset similar to the ones we have developed around some of our living labs. The knowledge asset presents what we have learned working together with a professional editor and can constitute a reference for others who are doing or wishing to do the same and who could share on a virtual platform their own experiences so as to enlarge and deepen the knowledge that we have developed insofar in the field of communicating disaster prevention and mitigation.

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**Figure 12. Knowledge kit (or asset) for the production of communication solutions for DRR and CCA**

- Monitoring overtime:
  - The number of people accessing the information channel on the specific topic
  - Creating feedback mechanism to assess the effectiveness of the communication strategy

- Choosing or defining the characteristics of the channel to be used
- Identifying the audiences of the casts to be produced
- Constructing layers of consequent information products given the characteristics of the channel
- Identifying the most suitable technique of video/audio/text production with respect to the audience and the content to be communicated
- Developing the production based on key words relative to the concepts and ideas one wants to convey

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4.7.2 Description of the main activities of the knowledge asset

a. Choosing the channels to be used.

The type of communication solution to be developed depends very much on the channel that has to be used: in radio casts one needs to be very clear and descriptive as images cannot be provided to support what the speaker says. However, those are kind of banal differences anyone can easily understand and get. Less easy for non-professionals is to understand that different media imply also different narrative time shaping also the content. For example a newspaper or even a news edition in the TV follow an emergency day by day, in the case of the TV hours by hours or even less if we talk about a news channel. On the other hand, a weekly magazine or a once a week news program need to synthetize what had happened in a whole week. The “news” is not new anymore, so more careful reflection and follow up arguments are required. In this case it is more useful to provide a sort of scenario of what the future may look like rather than insisting on specific aspects that have been already long discussed and said over an entire week.

When somebody has to give an interview on the radio key messages should be provided at the beginning, reserving more explanatory issues and premises to the end of the cast.

Using a Web based TV one has to consider the potentialities of the tool, permitting to layer information and knowledge according to increasing levels of detail, conceptualization, providing opportunities for different audiences to find what fits best their knowledge requirement. Somehow the idea of the market that we provided as a framework for an effective knowledge management system at the beginning of this chapter is easy to apply on a web-based platform that can be design so as to satisfy different knowledge and informational demands.

Know what: the professional expertise of an editor is important to be able to tailor the communication solutions to the type of channel to be used; on the other hand researchers and stakeholders’ expertise in the field of DRR and CCA is important to provide the content, to provide the scientific, organizational and legislative knowledge.

Know how: examples of the communication solutions that have been developed in the context of the project can be used in the knowledge kit as a reference, together with text commenting on the techniques used to develop them. It is fundamental to keep in mind the multi-dimensionality of the media, their different characteristics in terms of how the message should be best presented, using what narrative timeline, where to put the emphasis at the beginning, how to conclude etc.

b. and c. Identifying the audiences and targeting the messages

It is of paramount importance to to able to distinguish different types of audiences among the so-called “general public”. Using a web based TV for example it is possible to provide different contents related to the same topic to different audiences like mayors, for example, volunteers associations, communities living in hazardous areas, etc. However there is a further distinction that needs to be carefully considered and relates to the spatial scale at which the media operates. In fact a national radio or TV does a very different job with respect to a local one. Here the media are much closer to the community, and the community needs to give voice and possibility to express anxieties, fears, very specific issues that are relevant to the local people. Local media have therefore a different goal and task when talking about risks, disasters, climate change; they need to find examples of both
problems and solutions that are highly contextualized and favor the engagement of the people and the inclusion of their knowledge acquired from the past, from family, friends etc.

Know what: one has to know how to target different audiences and to prepare content accordingly. In this regard for example developing a discourse on the basis of predefined keywords proved to be useful. The keywords define the specific goals or the specific issues that one wants to develop in a discourse for different stakeholders’ groups.

Know how: again the expertise of a professional editor is important in defining what message can be conveyed and what cannot given the arena where one has to act, the specific time (peace time or right after a disaster), the specific audience. In a scientific dissemination format also controversial issues can be tackled in a more adequate and scientific way, comparing for example the different positions and opinions. In a news session, right after an event, one cannot suggest for example that people should learn how to adapt to disasters, that natural hazards cannot be avoided, etc. Affected people are in a very sensitive condition and it is not the right moment and situation to think calmly about living with risks.

d. Identifying the most suitable technique to convey a given type of message to the most suitable type of audience.

There are different ways to convey a certain type of message regarding prevention, mitigation and preparedness to different audiences. In the project we have experienced: video interviews, shooting documentary videos showing the activity of the civil protection in post-flood damage assessment (in the Umbria living lab), shooting participatory events alternated to explanatory interviews (for the game played in Bolzano).

Know what and Know how: The selection of the technique drives on the experience of the professional editor, but the type of environment that one wants to create is a matter of discussion among all the participants to the communication session. In this regard for example it was decided that in the shooting of the Umbria case the filmmaker will stay somehow behind the people carrying out the surveys on damaged buildings and talking to the affected people, so that the latter will not feel “on stage”. They even did not notice the microphone that was kept discretely at a distance from them. This technique is called: anthropologic shooting.

e. Monitoring the communication effect

Monitoring the result of communication is an ordinary task for those developing marketing campaigns for example, however it is less frequent among those developing communication tools for emergency preparedness or risk prevention for civil protection authorities for example. It is nevertheless important to assess the effectiveness of the results of a communication campaign, to assess if the invested effort is compensated by the results.

Know what: one may consider different indicators to decide if a communication campaign has been effective or not, starting from the distribution of questionnaires to the audience. Techniques in this field constitute an expertise per se and it would be extremely useful to refer to some in the knowledge kit.

Know how: especially in the digital area it has become easier to know how many people clicked for example a given site: more difficult is to find feedback mechanisms for judging the quality of the communication, if it encountered or not the interest of the audiences one had to target.
4.8 How such knowledge can be represented in the knowledge asset and who could contribute to its continuous update and co-production.

The knowledge that has been described in the previous paragraph may be conveyed through different tools and in different forms such as:
- Pdf documents related to guidelines, reports, case studies that are available in literature and/or have been produced by public administrations and made available in the internet. The knowledge asset could either provide an access to the site where such documents can be downloaded or archive it so as to guarantee access for a longer period.
- Pdf documents that have been developed by the same community of practice and that can be reference in future work.
- Interactive survey forms that have been developed for collecting data in the field.
- Applications to carry out individual tasks, etc.

What has been described in section 4.5 for example is a sort of compendium of the results of the Umbria living lab, so the knowledge that is represented in the knowledge asset and its specification have been developed and shared among the stakeholders who are part of the Umbria Community of Practice: the Umbria Region Civil Protection Authority, the researchers of the Politecnico di Milano, the representatives of municipal and other regional administrations who participated to the various meetings and debates that were necessary to discuss and develop the methodology and the procedure. When put online in a web platform, the different knowledge, information and examples that will be shared will represent just an instance of how the problem of carrying out multi-purpose post flood damage assessment can be tackled. In the platform though, thanks to the applications and the virtual sharing spaces that can be created, many more instances and many more examples can be provided by other teams working on the same problems. The platform itself can become a place where new knowledge on the topic can be created, by adding documents, forms, details in a structured way. The essential here is that the platform should provide the structure for sharing and co-developing the new knowledge. An example of how the interface of such a platform may look like is provided in Figure 13.

We are aware of course that the different knowledge kits that can be developed starting from the experiences of the Know-4-drr project are not standing alone and could and actually should be connected one to the other. For example the knowledge kit for developing communication solutions could be intersected with the Umbria or the Po River Basin knowledge kits, in the sense that in both living labs the necessity to reach a wider set of different audiences than the stakeholders participating to the community of practice was raised and in some cases even satisfied as in the example of the Umbria living lab video.

4.8.1 The implementation of the Knowledge kit for the post-flood damage assessment, adapted to the Umbria Region

The knowledge kit (or asset) described in the previous paragraphs has been designed and implemented as an online platform in order to make it public (i.e., knowledge as a public good is a condition of our KW Marketplace), accessible and useable by the largest number of stakeholders interested in understanding/developing a post-flood damage assessment.
This is a sample of how we can present this knowledge, a solution that may be represented differently (offline for example), or using social media (e.g., Facebook groups features), taught in a frontal classroom or in an e-learning platform.

The homepage of the platform in Figure 13 presents the steps that have to be performed in order to complete the kit, as a sequential workflow or as separated activities (to be performed in parallel by accessing to each of them independently from the page menu).

The image in Figure 14 presents the 5 steps workflow to produce a complete post-flood damage assessment report as a recurrent cycle that may be performed once or more in order to refine it. Each step is presented by a sub-process that is accessible directly from the interface by clicking on the horizontal menu in Figure 15.

Figure 13. The online Knowledge kit for post-flood damage assessment

Figure 14. The online Knowledge kit workflow for post-flood damage assessment (Umbria Region living lab)
Each accessed page (functions that should be implemented in next activities) would present the activities, tools, samples of data produced (maps, pdf files, reports, etc.) as described in the paragraph 4.8.

This sample of a web portal to share a co-produced knowledge in a living lab about damage assessment is a concrete product that may be replicated for other case studies and it constitutes the “first” level of the implementation of the DRR Knowledge Marketplace proposed by the project KNOW4DRR.

The sample is a step forward in the attempt to translate the framework of a KMS in the shape of a marketplace working in a virtual space, a platform, accessible to all stakeholders, in which the different KWDRR KITs might be offered, if already existing, or produced based on interactions and exchange of knowledge flows and demand-supply-production chains among the different stakeholders categories. Actually, in the case studies and Living Labs of the KNOW4DRR project, the availability of such knowledge products on a platform as they have been proposed in the previous paragraphs is in our view an important demonstration of the capacity of a community of practice to develop knowledge kits demand driven.

In a future development of the envisaged platform, a space might be designed to let demanders, for instance civil society representatives, to explicit their requirements and requests and to transfer the demand to producers and suppliers. At the same time, the platform functioning might let the final users express their opinions about what is already available, giving a feedback to knowledge producers. The potential continuous exchange of knowledge flows might also be useful to recognize some prevalent KWDRR KITs, in order to adapt them to different territorial areas and/or to translate them according to different cultures characterizing communities of stakeholders.

Actually, the next step of the implementation of the Knowledge Management Framework that we propose would be an interactive web application (online application) that permits to its users not only to access to a knowledge kit (or a set of knowledge kits) but also to propose their own vision, to integrate their tested solutions, to insert their case-studies (or parts of them), to recommend new tools for mapping, analyzing, etc. An interactive platform would be the form in which a knowledge Marketplace may put together stakeholders knowledge from different countries and regions holding different but complementary visions of DRR and CCA: an online Marketplace were to make meet the knowledge of various stakeholders as the “offline” living labs of the KNOW4DRR project permitted to do.
5 Conclusions

When we proposed the development of a Knowledge Management Framework for the support and coordination action under which the Know-4-drr project was funded we had mind some ideas and the need to develop something that may be of use for the disaster and climate change communities. We also considered that such tool should respond to the need of a rather large variety of organizations and groups, roughly categorized as private and public sectors, scientists or researchers, and the so-called “civil society”. The different activities undertaken during the project, the various analyses carried out from different perspectives, building on the consortium diverse disciplinary and cultural background permitted to actually unveil what are the most urgent needs in terms of knowledge sharing, production and maintenance. We started from the recognition of “barriers” among disciplines and stakeholders, but were not too satisfied by those categories that seemed to simplify too much a reality that appeared to be increasingly articulated and complex as we learned more and as we established closer links with some stakeholders pertaining to the different groups and among us as pertaining to different professional and research fields.

In order to develop a knowledge management system more than just “bridges” among stakeholders and research fields is needed: a real close cooperation and co-production of knowledge among partners that share common goals and to a certain extent also a vision about what is knowledge, what is knowledge in action and ultimately what is wisdom.

With some caution we dare to say that we have achieved more than what we expected from ourselves at the beginning of the project, as ready-made solutions or solutions in close fields that we could take as a reference were not available and we have to make a significant work of imagination and creation. In the last internal meeting of the project that was held in Chambery on the 28th May morning partners seemed to converge to the idea that the result of the knowledge management framework deliverable was more than satisfactory. Since then many if not all the suggestions and ideas for improvements were added to the draft text that was available for the meeting in Chambery.

Certainly, the effort invested in producing the framework has been larger than envisaged, however we feel it was worth it. We believe it would be interesting to develop further the idea of the platform we described here, perhaps in conjunction with one of the networks that have participated to the Salzburg Workshop and have already a large experience on what it does entail developing and running a platform like the one we have envisaged based on the idea of the market for sharing and co-producing knowledge across boundaries, spatial borders and time scales.
6 Bibliographical references


Duncan, C., Scherer, S., Wade Apicella, S., 2014. HFA Thematic review: research area 2, priority for action 3, core indicator 3. Relevant information on disasters is available and accessible at all levels, to all stakeholders (through networks, development of information sharing systems etc.), Background paper preapared for the 2015 Global Assessment Report on Disaster Risk Reduction, November 2014.


