Executive Summary:

MOVE - Improvement of Methods for Vulnerability Assessment in Europe - is an applied research project which has been designed to produce results that are directly useful for recognising and characterising vulnerability to natural hazards and climate change in a European setting. In order to accomplish this, it investigated the theoretical side of vulnerability to natural hazards, the state of the art regarding vulnerability assessment and the means of developing new and enhanced tools for identifying, measuring and gauging the effect of vulnerability in a wide variety of European environments. Finally, it sought to involve the potential beneficiaries of the research so that they could appreciate the vulnerability problem, perceive it with sufficient accuracy, act to improve resilience, perceive the benefits of working with the project and can feel comfortable to use the methodologies proposed.

MOVE considered vulnerability to eight natural hazards and climate change. The hazards were floods, temperature extremes, droughts, landslides, avalanches, coastal erosion, earthquakes, wildfires and storms. The aim was to create knowledge, frameworks and methods for the assessment of vulnerability to natural hazards in Europe. To do this, MOVE used indices and indicators to help improve societal and environmental resilience placing emphasis on clear, capable measurement and accounting for uncertainties. It also identified gaps in existing methodologies and produced a conceptual framework that is independent of scale and hazard type. With this, it was able to analyse physical, environmental, economic, social, cultural and institutional vulnerability measured for specific hazards and at different geographical scales.

MOVE made use of case studies throughout Europe. These were distributed among mountain, hill, floodplain and coastal environments, metropolitan, city, town and rural areas, and northern, central and southern European locations. Methodologies were tested in case study regions for vulnerable elements and appropriate hazard types. Case studies enabled the availability and quality of existing data to be examined at sub-national (NUTS 3-5) and local scales. The seven MOVE case studies integrated methods of estimating potential economic damage and social vulnerability.

MOVE involved 13 institutions from nine European countries. It also made contact with a series of stakeholders, representing potential end-users of its products. These were consulted and involved in meetings and project workshops so that their viewpoints could be used as input to the final project results. MOVE produced a Manual of Vulnerability Assessment in Europe, which outlined the methodologies that can be used for estimating, studying and analysing multi-faceted vulnerability to natural hazards. To accompany the manual, it produced a Handbook of Vulnerability Assessment in Europe, which presented the seven case studies as illustrations of how the methodologies could be applied in practical situations. Other products of the MOVE project included a glossary of terminology associated with vulnerability assessment, an assessment of the state of the art in this field, a holistic general framework for addressing vulnerability to natural hazards, and a paper on lessons learned from the process and practice of assessing vulnerability.

Project Context and Objectives:

MOVE - Improvement of Methods for Vulnerability Assessment in Europe - is an applied research project which has been designed to produce results that are directly useful for recognising and characterising vulnerability to natural hazards and climate change in a European setting. In order to accomplish this, it investigated the theoretical side of vulnerability to natural hazards, the state of the art regarding vulnerability assessment and the means of developing new and enhanced tools for identifying, measuring and gauging the effect of vulnerability in a wide variety of European environments. Finally, it sought to involve the potential beneficiaries of the research so that they could appreciate the vulnerability problem, perceive it with sufficient accuracy, act to improve resilience, perceive the benefits of working with the project and can feel comfortable to use the methodologies proposed.

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The MOVE partnership defined vulnerability as the 'degree of susceptibility or fragility of elements, systems or communities'. This definition includes another term which is not usually used in every-day conversations, namely 'susceptibility'. Within MOVE, susceptibility was understood as the 'likelihood that particular areas or societies will be affected by a natural hazard or by climate change.' In this sense, vulnerability is concerned with natural hazards and the capacity to cope, i.e. to react to a perceived or experienced hazard or risk in the short-term.

MOVE partners developed a generic conceptual framework for vulnerability assessment. This was first and foremost a theoretical exercise, but it sought validation by those who are practically affected by disasters and hazards. Hence, practical considerations were furnished by disaster risk managers and other key stakeholders in order to offer the desired real-life feedback and validation of the theoretical concept that the project developed.

The process of creating the generic framework began with the compilation of a glossary of essential terms to be employed during the project. There are many potential definitions of terms such as vulnerability, susceptibility, exposure, risk, adaptation and governance. The main purpose of the glossary was to ensure that the project participants, and external stakeholders, were clear about the consensus definitions used in the project. The second stage was to make a state-of-the-art review of the theory and methods associated with vulnerability assessment. This involved in-depth reviews of almost 100 key publications and the compilation of a paper that summarised their most important findings and identified the current level of development of concepts in this field. Past models of vulnerability were assessed in order to create a new model from which the project could work. Besides the general literature overview, a specific report was produced in order to summarise the state of the art regarding vulnerability assessment for geohazards and climate change.

On the basis of the state of the art, MOVE partners produced the generic conceptual framework for vulnerability assessment, which can be summarised in the following diagram.

The framework considers the different components of vulnerability: physical, environmental, social, economic, cultural and institutional. It places special emphasis on the interactions between components, and on the factors that modify or qualify vulnerability, namely, resilience, adaptation, coping capacity, hazard intervention and risk management. It was recognised that risk governance is at the root of any successful strategy to manage and reduce vulnerability to natural hazards. The framework also allows for its application at different geographical and temporal scales of analysis. The main utility of this diagram, and the analysis that accompanies it, is to ensure that the methods and results of different vulnerability assessment studies are compatible and that they can contribute to a common effort to reduce vulnerability comprehensively in European settings.

Although penetrating analyses can be conducted of each single element of vulnerability for example, the physical susceptibility to harm of buildings it is recognised that vulnerability can only truly be understood if the approach is holistic. Hence, the MOVE consortium produced a report on how to conduct holistic analyses in this field. The complexity of vulnerability in most European environments is a result of the linkages between each component of the problem, and the way that they influence each other. Hence, much attention was given to the analysis of linkage mechanisms, recognising that vulnerability is fundamentally a socio-economic problem that is susceptible to many physical and environmental influences.

Once the conceptual framework was fully mapped out, consortium partners proceeded to test it in the field. MOVE made use of case studies distributed throughout Europe. These were situated among mountain, hill, floodplain and coastal environments, metropolitan, city, town and rural areas, and northern, central and southern European locations. Methodologies were tested in case study regions for vulnerable elements and appropriate hazard types. Case studies enabled the availability and quality of existing data to be examined at sub-national (NUTS 3-5) and local scales. The seven MOVE case studies integrated methods of estimating potential economic damage and social vulnerability.

Barcelona (Spain). The Barcelona case study addressed the urban disaster risks caused by earthquakes and floods. It made a probabilistic evaluation of damage scenarios and calculated probable economic impacts. It also considered the aggravation of impact scenarios as a result of high socio-economic vulnerability and the lack of resilience of the city. Disaster risk management performance evaluations were made in order to assess institutional and socio-cultural perspectives on capacity to cope.

Salzach River / Danube (Austria). The Salzach/Danube river basin case study focused on vulnerability to landslides, avalanches, floods and flash floods. Methods were developed to identify and measure the physical and environmental vulnerability of Alpine regions, as well as their socio-economic vulnerability patterns. Particular emphasis was given to the issue of up- and down-scaling of indicators and the generation of new data using remote sensing.

Tuscany (Italy). The case study on cities in central Tuscany (Prato, Pistoia, Florence and Lucca) focused on the vulnerability of city-regions to earthquakes, floods, storms and landslides. Architectural, social, institutional and economic vulnerability were assessed at the city-region level. Scenarios for floods and earthquakes were developed and applied in order to assess the response capability of the local medical system when faced with mass-casualty disasters.

Cologne / Bonn (Germany). The Cologne/Bonn case study tested methods designed to measure the vulnerability of urban agglomerations on floodplains to floods, droughts and temperature extremes. Earthquake hazards were also taken into account. The indicators used measured socio-economic, infrastructural, cultural, institutional and economic vulnerability. The geographical scale ranges from neighbourhoods to the NUTS 5-3 level. The originators of this case study collaborated closely with the teams involved in the London and Barcelona studies.

London (UK). The London case study focused on the local-level vulnerability of the British capital to high temperatures and drought. Socio-economic and cultural vulnerability were of special interest. Methods used encompassed the analysis of local statistics, as well as the employment of a sensitivity assessment tool. Analyses were conducted on levels from neighbourhoods to city-wide. Interviews, workshops and questionnaires were used.

North-West Portugal. The North-West Portugal case study examined methods to measure economic, social and environmental vulnerability to forest fires, coastal hazards and mass movements. The research targeted the local level and includes urban and rural settings. It considered the relationship between human settlement and wildfire hazard, and the impact of increasing duration of the fire season and magnitude of fires.

South Tyrol (Italy). The South Tyrol case study complemented the development of methods to measure vulnerability in mountain regions. It tested and refined methods designed to measure vulnerability to avalanches, flash floods, landslides and temperature extremes, which are all expected to increase as a result of climate change. While the Salzach case study focused primarily on the sub-national level, the South Tyrol case study complemented it by looking at the local scale. The Tyrol case study put emphasis on institutional, economic, socio-cultural and physical vulnerability issues.

MOVE involved 13 institutions from nine European countries. It also made contact with a series of stakeholders, representing potential end-users of its products. These were consulted and involved in meetings and project workshops so that their viewpoints could be used as input to the final project results. MOVE produced a Manual of Vulnerability Assessment in Europe, which outlined the methodologies that can be used for estimating, studying and analysing multi-faceted vulnerability to natural hazards. To accompany the manual, it produced a Handbook of Vulnerability Assessment in Europe, which presented the seven case studies as illustrations of how the methodologies could be applied in practical situations. Stakeholder workshops were held in different parts of Europe and both on behalf of the consortium as a whole and by individual partners. At these, the views of potential users of the MOVE methodology were taken into account so that they could be incorporated into the final deliverables of the project.

Project Results:

Note: In this report the beneficiaries, or partners, of the MOVE project will be referred to by their short abbreviated names, as follows:

UNIFI - University of Florence, Italy

BRGM - French Geological Survey, France

Z_GIS - Centre for Geoinformatics, University of Salzburg, Austria

EURAC - European Academy, Institute for Applied Remote Sensing, Italy

ATLAS - Atlas Innoglobe Tervezö és Szolgáltató, Hungary

KCL-AC - King's College, University of London, United Kingdom

NGI - Norwegian Geotechnical Institute, Norway

RC - Rupprecht Consult Forschung und Beratung, Germany

CIMNE - Technical University of Catalonia, Spain

UNU-EHS - United Nations University, Institute for Environment & Human Security

UNIDO - University of Dortmund, Germany

FLUP - University of Oporto, Portugal

UNIVIE - University of Vienna, Austria

Introduction

In many respects, vulnerability is the essence of disaster risk. The impact of any given physical force may vary substantially from one environment to another according to the level of vulnerability of the built, natural, social and economic environments. In fact, the many categories of vulnerability reflect the complexity of modern European society. In the face of emerging risks (some of which are related to climate change) and intensifying natural hazards, vulnerability is the key to understanding how society, economy and environment will react to the hazards of the future.

Because of its multi-faceted nature, vulnerability is difficult to estimate in any comprehensive way. It has both sectoral and holistic connotations. The former include the fragility of livelihoods, homes and productive capacity affected by disaster risk, and the latter comprise governance and culture, as well as the impact of social decision-making on the physical and built environments.

Conceptual framework

The conceptual framework recognizes hazards, which can be natural or socio-natural, and the society, represented at international, national, subnational or local scale, as being part of the environment; both elements, hazards and society, coexist and have constant interactions among them.

In general, the concept of hazard is used when referring to the potential occurrence of natural, socio-natural or anthropogenic events that may have physical, social, economic and environmental impact in a given area and over a period of time. Therefore, a natural hazard means the potentiality of internal or external geodynamics or hydro-meteorological events that may cause effects to exposed elements. When the intensity or recurrence of hazard events is related to processes of environmental degradation and human intervention in natural ecosystems, the origin of hazard can be considered as socio-natural. They are created where human activity intersects with natural ecosystems.

Society is exposed in the time and space to different hazards, and it can be vulnerable to them. The vulnerability of the society depends on several factors related to thematic dimensions:

1. Physical dimension: fragility of physical assets including built-up areas, infrastructure and open spaces that can be affected by natural hazards. This dimension depicts locations in susceptible areas and deficiencies in the resistance of the exposed elements.

2. Ecological dimension: fragility of ecological and bio-physical systems and their different functions, under a hazardous condition, to suffer damage and deterioration.

3. Economic dimension: fragility of a community, under a hazardous condition, related to potential financial damage and/or disruption of productive capacity.

4. Social dimension: Fragility of the community related to the level of human welfare including its social integration, mental and physical health, both at an individual and collective level.

5. Cultural dimension: fragility of communities, under a hazardous condition, related to the meanings placed on artifacts, customs, habitual practices and natural or urban landscapes.

6. Institutional dimension: fragility of systems or communities, under a hazardous condition, related to both organizational form and function as well as guiding legal and cultural rules in order to perform risk management.

Vulnerability reflects the susceptibility or the intrinsic predisposition to being affected or the conditions that favour or facilitate damage. The measurement of vulnerability is a challenge; it is related to the degree of exposure, susceptibility, fragility and lack of resilience of a socio-ecological system that favours adverse effects. These causal factors of vulnerability are defined as follows:

1. Exposure is the susceptibility of human settlements and environment to be affected by a dangerous phenomenon due to its location in the area of influence of the phenomenon and to a lack of physical resistance.

2. Fragility is the predisposition of society and ecosystems to suffer harm resulting from the levels of susceptibilities or fragilities of human settlements and disadvantageous conditions and relative weaknesses related to physical, ecological, social, economic, cultural, and institutional issues.

3. Lack of resilience is the limitations in access to and mobilization of the resources of the human settlements and their institutions, and the incapacity to adapt and respond in absorbing the socio-ecological and economic impact. The resilience includes the capacity to anticipate, cope and recover.

Risk is defined as the potential occurrence of physical, social, economic, and environmental consequences or losses, in a given area and over a period of time, resulting from the vulnerability conditions of a socio-ecological system exposed to hazards. In order to face the recognized risk, it is necessary to involve the risk governance which includes the totality of actors, rules, conventions, processes and mechanisms concerned with how relevant risk information is collected, analysed and communicated and management decisions are taken. These risk management decisions include tasks on risk reduction, prevention, mitigation and transfer and also preparedness and disaster management, which allow implementing measures for hazard intervention or vulnerability intervention that lead to exposure and susceptibility reduction and resilience improvement.

Adaptation means 'adjustment' in natural or human systems to a new or changing condition; i.e. the ability of an individual or group to adjust to changes in the natural and built environment. Overall, adaptation can be anticipatory or reactive, autonomous and planned. Adaptive capacity requires techniques and strategies to be devised that enable society to absorb and deflect the impact of hazards.

The generic concept and framework defines the major characteristics and pillars of vulnerability. It will answer the question of whether vulnerability should be considered solely in terms of susceptibility and fragility, or whether it should also encompass ability to cope and adapt to changing environmental conditions and shocks, such as floods, landslides and earthquakes. It will also provide guidance on what physical, technical, social, economic, environmental, institutional and cultural vulnerability mean and how they can be assessed. Due to the stochastic aspects of the natural, built and social environments, uncertainties are an intrinsic part of any attempt to estimate vulnerability and are also present in the methods and models used to qualify or quantify it. As a result, uncertainties will explicitly be evaluated, reported and discussed with stakeholders and end-users. This will provide different stakeholders with a measure of the confidence level of estimates.

There are a wide range of approaches for integrating data and modelling risk and vulnerability. Inductive approaches model risk through weighting and combining different hazard, vulnerability and risk reduction variables. Deductive approaches are based on the modelling of historical patterns of materialized risk (i.e. disasters, or damage and loss that have already occurred). Other approaches combine the results of inductive and deductive modelling. An obstacle to inductive modelling is the lack of accepted procedures for assigning values and weights to the different vulnerability and hazard factors that contribute to risk. Deductive modelling will not accurately reflect risk in contexts where disasters occur infrequently or where historical data is not available. In spite of this weakness, deductive modelling offers a short cut to risk indexing in many contexts and can be used to validate the results from inductive models. There are no standard procedures for measuring or weighting the effectiveness of risk reduction, given the large number of stakeholders and the wide variety of activities involved.

Vulnerability and risk indicators or indices are feasible techniques for risk monitoring and may take into account both the harder aspects of risk as well as its softer aspects. The usefulness of indicators depends on how they are employed. The way in which indicators are used to produce a diagnosis has various implications. The first relates to the structuring of the theoretical model. The second refers to the way risk management objectives and goals are decided on. This aspect is important given that it is preferable to promote an understanding of reality not in strict terms of the ends to be pursued, but, rather, in terms of the identification of a range of possibilities, information on which is critical to organize and orientate the praxis of effective intervention. An appropriate technique based on indicators can be a rational benchmark or a common metric to rule the risk variables from a control

point of view. The goal is not to reveal the truth, but rather to provide information and analyses that can improve decisions.

It is important to recognize that complex systems involve multiple facets (physical, social, cultural, economic, institutional and environmental) that are not likely to be measured in the same manner. Physical or material reality has a harder topology that allows the use of quantitative measurement, whilst collective and historical reality has a softer topology where the majority of the qualities are described in qualitative terms. These aspects indicate that a weighing or measurement of risk involves the integration of diverse disciplinary perspectives and this may usher in problems of comparability. In other words, in order to measure risk and its management we need a holistic focus. This type of integrated and interdisciplinary focus can more consistently take into account the non-linear relations of the parameters, the context, complexity, and dynamics of social and environmental systems, and contribute to more effective risk management by the different stakeholders involved in risk reduction decision-making. It permits the follow-up of the risk situation and the effectiveness of the prevention and mitigation measures can be easily achieved. Results can be verified and the mitigation priorities can be established with regard to the prevention and planning actions to modify those conditions having a greater influence on risk.

In general, a good methodology for vulnerability and risk assessment in Europe, useful to reach the objectives of the MOVE project, should have a set of characteristics that are the following:-

1. To be easy to apply, to adapt, to use, to update and to understand.
2. The obtained results by using the methodology have to be usable in the decision making process of disaster risk management, like for example: land use planning, risk reduction measures, etc.
3. The comparison among case of studies of the same spatial scale (cities, countries, regions) should be possible.
4. It should be flexible in use: selection of indicators, variables, weights, etc.
5. It should be applicable or easy adaptable to other spatial scales.
6. It has to involve the stakeholders in the process of evaluation.
7. The obtained results should communicate the vulnerability and risk in terms easy understandable by the stakeholders.
8. It has to have wide potential application.
9. It should allow monitoring the risk and vulnerability evolution across the time.
10. It has to be based on a comprehensive and holistic approach of risk and vulnerability, combination of physical and structural information with social and population data.
11. It has to be participatory.
12. The obtained results have to be geographical visualized.

On the other hand, the quality attributes of the methodology, in general, should be represented by its applicability, transparency, presentation, and legitimacy. Respect for these attributes determines the

scientific pedigree of a particular technique. Applicability refers to the way a model is adjusted to the evaluation problem at hand, to its reach and comprehensiveness, and the accessibility, aptitude, and level of confidence of the information required. Transparency is related to the way the problem is structured, facility of use, flexibility and adaptability, and to the level of intelligibility and comprehensiveness of the algorithm or model. Presentation relates to the transformation of the information, visualization, and understanding of the results. Finally, legitimacy is linked to the role of the analyst, control, comparison, the possibility of verification, and acceptance and consensus on the part of the evaluators and decision-makers.

Lastly, political decisions on risk are taken under conditions of uncertainty and are based on data of variables and, at times, of undetermined quality. This may be complicated by the political manipulation of uncertainty in order to speed up or slow down a decision and action. Quality, understood as the ability of a product to satisfy determined requisites, is the concept that underlies the determination of its attributes and criteria that allows an analysis of the decision-making process. Hence, the key question is: what is the role of the information in decision-making? Once the problem of designing criteria has been resolved, the following question arises: who will determine the criteria to be used? Uncertainty with regard to risk and the fact that the scientific community can not possibly resolve and characterize these problems totally (given that no expert can provide certainty for political decisions) has led to a request for the inclusion of more actors, including the community, into the decision-making process. This permits a plurality of perspectives which, whilst not denying the competence of experts, permits the inclusion of a wide range of stakeholders in decision-making. It provides a combination of skills that permit all those involved in the problem to enrich the collective vision. Thus, the determination of criteria must be arrived at by dialogue and cooperation between experts, decision-makers, and other relevant actors, using the notion of quality as a baseline.

The models that are applied in the design of public policies such as risk management may influence the quality of the decision process. Opting for one type of modelling over another (for instance, mono- as opposed to multi-criteria models) may lead to different results which then push public policy objectives in a determined direction. Therefore, despite what many believe, the design of a public policy like risk management is very much related to the evaluation technique used to orient that policy. The quality of the evaluation technique, called by some as its scientific pedigree, has unsuspected influence on policy formulation. If the diagnosis invites action it is much more effective than where the results are limited to identifying the simple existence of weaknesses or failures.

In conclusion, the development of techniques that permit a permanent monitoring of territorial and social accumulation of vulnerability or the evolution of physical trigger processes is conducive to the application of realistic and dynamic planning techniques. This should be flexible enough to adjust to continuous or abrupt changes in the natural, economic, and social environment. This type of corrective and prospective approach is more appropriate than the unidimensional approaches, given the levels of uncertainty and instability that characterize existing processes of change and which render long term plans almost impossible to realize. In many places economic, social, and cultural factors are becoming increasingly relevant for the dynamics of growth and progress. In view of this, we need to develop less rigid planning models that allow us to more adequately incorporate uncertainty, instability and surprise, using diagnostic and follow-up techniques that permit the monitoring of the social and environmental context and possible perturbing agents.

The MOVE contribution

Europe is a densely populated continent with immense variations over short geographical distances in environment, culture, demography and economies. It is essential to develop methods for the accurate assessment of vulnerability to hazards. There is ample scope in modern Europe for major crises to develop as a result of natural extremes of both a climatic and a geophysical nature. Severe disruption is also caused by less extreme events. Hence, a comprehensive methodology is needed that is capable of providing a clear and reliable picture of vulnerability in all its forms, sectoral and holistic, that is applicable in diverse environments from rural areas to metropolises, from coasts to mountains, and with respect to diverse hazards that occur either singly or in combination, and may be enhanced by climate change. It is vital to have a simple means, with a high degree of usability, for the assessment of different kinds of vulnerability, a methodology that can be translated easily into something that will form the basis for planning and preparedness initiatives. The need for such an instrument is felt throughout Europe, as no part of the continent is free from natural hazards and climate change.

MOVE (Methods for Improving Vulnerability Assessment in Europe) is a European project that has created knowledge, frameworks and methods for the assessment of vulnerability to natural hazards in Europe. MOVE has identified gaps in existing methodologies and has produced a conceptual framework that is independent of scale and hazard type. Different dimensions of vulnerability such as physical (technical), environmental, economic, social, cultural and institutional vulnerability have been analysed and measured for specific hazards and at different geographical scales. Floods, temperature extremes, droughts, landslides, earthquakes, wildfires and storms have been studied. The developed methodologies have been tested in seven case study regions on vulnerable elements and appropriate hazard types. Case studies enabled the availability and quality of existing data at regional and local scales to be examined. The generic framework, data analysis and applicability tests have resulted in a standard approach to vulnerability assessment in Europe. Stakeholders have been consulted systematically from the earlier stages of the project in order to understand their needs and to enable MOVE to draw attention to the practical value of its methodologies. In this paper, we look back at the aims of the project and at which point these aims were fulfilled. We outline the lessons that have been learnt by the case studies and the lessons that are still to be learnt by using the products of MOVE. Emphasis is given to the feedback of external experts and stakeholders that provided feedback during the implementation of the project.

Project response to MOVE aims

MOVE s aim was to contribute to the improvement of knowledge, methodologies, and integration strategies for the assessment of vulnerability in Europe. In more detail, the project s main aims can be summarized as follows:

1. The development of a framework designed to improve methods for the assessment of vulnerability to natural hazards. This implies that different hazards are taken into account as well as different landforms, such as floodplains, mountain regions and coastal areas. The scales examined will vary from sub-national to local.

2. The identification of gaps in existing vulnerability assessment methods and the development of vulnerability assessment methods for different dimensions.

3. The production of key indicators, indices and criteria that can be used to assess different aspects of vulnerability, in order to ensure synthesis, rather than fragmentation and isolation.
4. The application of the developed methodologies and their refinement in case studies.
5. The involvement of stakeholders for each case study in order for them to be integrated into the development of standards for a better vulnerability assessment framework that will improve decision making in Europe.

The expected impacts of the project were:

1. The development of a standard methodology for vulnerability assessment in Europe
2. The improvement of risk estimation
3. Better promotion of disaster resilience culture.

The generic vulnerability framework was the most discussed issue in the consortium and the most important product of the project. The generic framework considers the social and the ecological system and it recognizes hazards as being part of the environment. According to the framework, hazards and society coexist and have constant interactions with each other. The framework provides a common structure for existing formulated vulnerability assessment methodologies. It is independent of scale. Vulnerability essentially refers to the propensity of exposed elements (people and their livelihoods) to suffer damage and loss when impacted by hazardous events. According to the framework the measurement of vulnerability is related to the degree of exposure, susceptibility, fragility and lack of resilience. The framework accepts that vulnerability is multi dimensional (physical, ecological, social, economic, cultural and institutional dimensions). The framework provides also the link between vulnerability, risk and risk management. The role of risk governance, as the totality of actors rules, conventions, processes and mechanisms concerned with how risk information is collected, analysed and communicated and management decisions are taken, is emphasized. Risk management is conceived as a series of elements, measures and tools directed towards intervention in hazards and vulnerabilities with the objective to reducing existing and controlling future possible risks.

The MOVE partners agreed on a final version of the vulnerability generic framework in April 2010 and used the framework during the local stakeholder workshops in the case study areas. Beginning in 2011, the framework was presented to stakeholders to receive comments and recommendations for the further use of the framework.

The first step of the validation of the generic framework was the scientific validation done in London on 24./25. February 2011. The scientific validation was oriented on the generic framework as a whole and the interactions between the different pillars of the framework.

Four high-level scientific experts (Professor Janos J. Bogardi, former Director UNU-EHS, Professor Virginia Murray, Member of Science and Technical committee for UN International Strategy for Disaster Reduction (UNISDR), Professor Jean-Jacques Wagner, CERG, University of Geneva, and Philip Buckle, Coventry University) analysed the generic framework by its structure, content, and terminology in view of their particular expertise.

Generally the generic framework was seen as useful and a good mental guide for dealing with risks, hazards and vulnerability by all four experts. From a scientific point of view, the framework is well constructed and scientifically viable.

It was recommended to strengthen the role of risk governance and to add an annotation for simplifying the complexity of the framework. It was suggested to implement two very important aspects, i.e. the 'communication' as well as 'dynamics' within the generic framework. (Vertical and horizontal) Communication is the prerequisite when dealing with risk and strengthens the position of risk governance.

It was noted that critical infrastructure is a key-aspect in dealing with risk. Interrupted critical infrastructure limits the ability to offer help. The vulnerability of critical infrastructure depends on its degree of exposure, susceptibility, fragility and resilience.

Beside the critical infrastructure, also the aspect of 'health' (as an important dimension of vulnerability) should be seen as a crucial point when dealing with risk. It should be kept in mind that every natural hazard event has great impacts on 'health' (i.e. dead, ill etc.). This aspect characterises the vulnerability of a society (a multitude of people is exposed to risk, i.e. maternal, children, elderly, pre-existing disease etc). As the generic framework is a quite complex model it runs the risk to be too complicated. Therefore it was suggested to provide good annotation to the terminology and make the MOVE glossary clear and understandable.

The second validation workshop was organized in Salzburg in June 2011. Stakeholders from each case study were invited to Salzburg, not only in order to give their feedback on the individual case studies, but also to validate the generic framework and the project as a whole. It was a great opportunity to discuss not only about the framework but also about different vulnerability assessment methodologies, core vulnerability indicators, communication and data issues etc. Following a thorough presentation of the project and of the generic framework, the stakeholders discussed the strengths, weaknesses, opportunities and threats/risks of the framework.

In more detail, the stakeholders recognized the various strengths of the framework. They stressed that it provides better knowledge on the concepts and that it gives a good overview of the relationship of the different aspects. It is definitely a holistic approach and, in contrast with existing frameworks it has a strong vulnerability focus. It is flexible and applicable for many different hazard types and it strongly considers resilience.

They also pointed out some weaknesses such as its complexity and the difficulty of some stakeholders to understand it. A point that was raised by the stakeholders was the difficulty to understand the terminology. Apart from language problems (often some terms translated in another language mean something else), the fact that new terms are used together with new ones leads to confusion. Terms such as 'risk governance' and 'institutional vulnerability' were difficult to understand by the stakeholders. Another important problem, according to the stakeholders, is the lack of sufficient data to support the implementation of the methodologies. For example, some vulnerability indicators during the case studies could not be identified due to lack of relevant data.

However, they recognized that the framework offers also a number of opportunities for further use. The fact that the framework was used in several case studies in Europe giving positive results is for the stakeholders an indication that there are many opportunities for the framework to be used in the future. The stakeholders stressed that the framework is a good working tool, it is designed to improve and support vulnerability reduction strategies and it can form the basis for local and regional concepts

and also for educational training. The stakeholders also suggested that the framework could support the latest EU directives. The stakeholders have to deal always with regulations at European level and a methodology that reinforces this process is welcome.

The stakeholders referred to possible threats and risks in using the framework. In more detail, they considered that there is the possibility that it will not be accepted by the stakeholders, however, although the 'language' used might be a reason for that, it should not be simplified for this reason by the MOVE partners. The fact that some dimensions can be interlinked might also be a problem in its implementation. The lack of data and the alternative ways in acquiring it might lead to poor data quality which will then lead to unreliable results. The validation and upgrading of the data used is also an aspect to be considered. A risk in using the framework derives also from the fact that the involved institutions are usually divided.

Finally, the stakeholders made clear that what they need is a methodology for decision making and methods to acquire better knowledge on the different aspects. They requested a stronger link between the framework and the EU directives. They proposed that a guideline document should be compiled which will indicate the way to bring the framework in practical use, followed by training exercises. Moreover, the link between academics and practitioners has to be established.

Lessons learnt from the case studies

Once the conceptual framework was fully mapped out, consortium partners proceeded to test it in the field. MOVE made use of case studies distributed throughout Europe. These were situated among mountain, hill, floodplain and coastal environments, metropolitan, city, town and rural areas, and northern, central and southern European locations. Methodologies were tested in case study regions for vulnerable elements and appropriate hazard types. Case studies enabled the availability and quality of existing data to be examined at sub-national (NUTS 3-5) and local scales. The seven MOVE case studies integrated methods of estimating potential economic damage and social vulnerability.

The case studies will now be described briefly.

Barcelona (Spain). The Barcelona case study addressed the urban disaster risks caused by earthquakes and floods. It made a probabilistic evaluation of damage scenarios and calculated probable economic impacts. It also considered the aggravation of impact scenarios as a result of high socio-economic vulnerability and the lack of resilience of the city. Disaster risk management performance evaluations were made in order to assess institutional and socio-cultural perspectives on capacity to cope.

Salzach River / Danube (Austria). The Salzach/Danube river basin case study focused on vulnerability to landslides, avalanches, floods and flash floods. Methods were developed to identify and measure the physical and environmental vulnerability of Alpine regions, as well as their socio-economic vulnerability patterns. Particular emphasis was given to the issue of up- and down-scaling of indicators and the generation of new data using remote sensing.

Tuscany (Italy). The case study on cities in central Tuscany (Prato, Pistoia, Florence and Lucca) focused on the vulnerability of city-regions to earthquakes, floods, storms and landslides. Architectural, social, institutional and economic vulnerability were assessed at the city-region level.

Scenarios for floods and earthquakes were developed and applied in order to assess the response capability of the local medical system when faced with mass-casualty disasters.

Cologne / Bonn (Germany). The Cologne/Bonn case study tested methods designed to measure the vulnerability of urban agglomerations on floodplains to floods, droughts and temperature extremes. Earthquake hazards were also taken into account. The indicators used measured socio-economic, infrastructural, cultural, institutional and economic vulnerability. The geographical scale ranges from neighbourhoods to the NUTS 5-3 level. The originators of this case study collaborated closely with the teams involved in the London and Barcelona studies.

London (UK). The London case study focused on the local-level vulnerability of the British capital to high temperatures and drought. Socio-economic and cultural vulnerability were of special interest. Methods used encompassed the analysis of local statistics, as well as the employment of a sensitivity assessment tool. Analyses were conducted on levels from neighbourhoods to city-wide. Interviews, workshops and questionnaires were used.

North-West Portugal. The North-West Portugal case study examined methods to measure economic, social and environmental vulnerability to forest fires, coastal hazards and mass movements. The research targeted the local level and includes urban and rural settings. It considered the relationship between human settlement and wildfire hazard, and the impact of increasing duration of the fire season and magnitude of fires.

South Tyrol (Italy). The South Tyrol case study complemented the development of methods to measure vulnerability in mountain regions. It tested and refined methods designed to measure vulnerability to avalanches, flash floods, landslides and temperature extremes, which are all expected to increase as a result of climate change. While the Salzach case study focused primarily on the sub-national level, the South Tyrol case study complemented it by looking at the local scale. The Tyrol case study put emphasis on institutional, economic, socio-cultural and physical vulnerability issues.

Case study achievements

In the early stages of the project each partner carried out a thorough literature review of existing methods for vulnerability assessment and identified the gaps in the methods and developed their own methodology designed to fill this gaps. The gaps that were identified varied. For example, in Portugal vulnerability analysis was not until now part of the risk assessment. In South Tyrol case study (floods), small businesses and affected people got involved in vulnerability and risk governance. In South Tyrol (mass movement case study) an alternative way of damage assessment (photographic documentation) was used to close the gap of missing data that will enable the assessment of economic loss for future events. The development of a hospital performance index was the innovative aspect of the Florence case study (UNIFI) as well as an innovative modelling approach for weather extremes. The validation of indicators through a validation workshop was the innovative aspect of the Salzach case study. In London, a qualitative index was developed to assess social vulnerability and adaptive capacity to heat waves and drought hazards. By focusing on the role of social learning and behaviour in configuring risk, the London case study built on temporally static quantitative assessments of vulnerability, towards a more dynamic notion of risk management. Furthermore, in the same case study, the new 'vulnerability units' method minimised existing scale problems. Understanding and taking into account uncertainty was also an innovative aspect in the specific case study. Moreover, in contrast with existing studies, more elements related to the lack of resilience were taken into

consideration. In the case study concerning heat waves in South Tyrol there was a significant contribution in the identification of thresholds of various discomfort levels which is a topic that has been not thoroughly investigated until now.

Case studies response to aims and relevance to framework and guidelines

Each of the case studies contributed to the improvement of knowledge, methodology and integration strategies for the assessment of vulnerability in Europe in different ways. In more detail, some case studies contributed purely to the improvement of knowledge. For example, the Florence case study (UNIFI) contributed to knowledge of vulnerability regarding meteorological hazards. In the case study of South Tyrol (UNIVIE) a new way to document damage on buildings caused by debris flow was proposed. In this way valuable information regarding the physical vulnerability of buildings can be collected. ZGIS contributed also to the improvement of knowledge by integrating local knowledge and expertise in the Salzach case study. In the case of Portugal, the case study, apart from using the framework for two very important hazard types for Europe (forest fires and coastal erosion) it also made it relevant for the local level and introduce the vulnerability assessment component of risk assessment to the stakeholders that have been ignored until now. Some case studies used system wide approaches (e.g. Hospital performance index-Florence case study) that can ensure the transferability of the methods in other places in Europe. Some partners concentrated on new methods to assess vulnerability (Salzach case study ZGIS) trying to assess vulnerability in different scale levels of decision making. EURAC focused on the integration of stakeholders in the vulnerability processes by organising workshops and contributing in this way in the understanding of motives and attitudes that influence vulnerability. Moreover the case study for heat waves in Bolzano carried out also by EURAC is the first one of its kind. Some case studies concentrated on the link between different vulnerability dimensions. For example CIMNE (Barcelona case study) investigated the ways that social weaknesses and lack of capacities can influence the physical effects of natural hazards. KCL in London explored the link between risk management practices and adaptive capacity, and their impact on overall vulnerability in the system by carrying out a stakeholder-led assessment at the scale of risk governance and local adaptive behaviour. UNU and UNIDO investigated different dimensions of vulnerability concerning different hazards testing in this way the validity of the framework for various risk settings.

Each case study made use of the framework investigating different aspects of it. Nearly all the aspects of the framework were investigated in the case studies. All of the dimensions of vulnerability were investigated as well as all the aspects that are included under the vulnerability 'umbrella' such as susceptibility, fragility, exposure and lack of resilience. In particular resilience was considered in the majority of the case studies (Florence, Salzach, South Tyrol and London). The London study focused on the role of risk governance and adaptive capacity in shaping vulnerability. The Barcelona case study investigated among other aspects also the capacity to anticipate. Some case studies were also relevant to the part of the framework that is related to risk. For example the South Tyrol case study for mass movements and the hospital performance assessment of Florence case study are related to risk as they assess the economic potential impact of debris flow events in South Tyrol and the potential loss of hospital equipment respectively.

The case studies use a range of different methodologies all of which can be found in the toolbox (guidelines). Nearly all of the methods listed in the guidelines were used. For example, most of the case study used methods for the aggregation or weighting of indicators (Portugal, Salzach,

Barcelona). Methods related to GIS and remote sensing technologies were used during the implementation of the Salzach case study and the South Tyrol case study for mass movements (UNIVIE). The method of stakeholder involvement was used by EURAC in the case study for floods in South Tyrol, whereas an uncertainty analysis was carried out by NGI using the data and results from the case study of South Tyrol (mass movements). London used stakeholder involvement and consultations to undertake a qualitative assessment of the overall health of the risk governance system. Moreover EURAC in the heat wave case study used also tools such as GIS and remote sensing for spatial analysis and data acquisition respectively. Remote sensing, GIS and methods for statistical analysis were also used by UNU/UNIDO.

Case study results and validation

The results of most of the case studies were the expected ones. However, only two case studies (mass movement case study in South Tyrol by UNIVIE and UNU/UNIDO Colgne Case study) until now carried out a validation which demonstrated the reliability of the results. More case studies have also planned to validate their results. The added value of the results obviously varies for each case study and it had to do with improvement of knowledge, transferability, inclusion of vulnerability analysis in risk management, support of EC directives etc. For example, the added value of the results in the Florence case study (UNIFI) was the contribution to knowledge of the relationship between meteorological conditions and cardiovascular diseases, and the value of integrating scales in the quantitative and monetary evaluation of potential losses that affect the medical sector. In the case of Portugal, the added value of the results is connected to the fact that vulnerability analysis can contribute to the prevention measures planning. EURAC s added value of results as far as the flood and the heat wave case study are concerned was the improvement of communication among stakeholder groups. The London case study promoted dialogue between risk managers and local stakeholders, and provided government institutions with an assessment of risk management practices. In the case of Salzach case study (ZGIS) the added value was the development of a methodology that can be transferable in other places in Europe and implemented for different types of hazards. The methodology developed can also be used for the support of the existing EC Flood Directive. In the case study of Cologne (UNU/UNIDO) the added value of the results was the opportunity to visualise not only the information about institutional vulnerability and other detailed vulnerability maps but also the assessment of landscape functions that showed the role of the ecosystems in the vulnerability of urban areas.

Specific achievements of the case studies

The achievements of the case studies vary according to the gaps that they were filled in each case, methods used and hazard type. The integration of stakeholders is considered a success in the Portugal and South Tyrol (flood and heat wave case study). Moreover, FLUP (Portugal) achieved the integration of vulnerability analysis in the risk management processes in Portugal. The heat wave case study in South Tyrol was also the first of its kind in the area, raising awareness and changed the perception of the local authorities on the topic of heat waves. The London case study was used by the UK Health Protection Agency to review its risk management procedures and engage in improved dialogue with local level risk managers and community members. The successful application of the framework is also an achievement for the case studies of Salzach and Barcelona. Moreover, the

Salzach case study achieved the representation of vulnerability independent from administrative units and the direct application of their methodology in the existing EC Flood directive. The new documentation for damage assessment and the tool for economic loss estimation proposed by UNIVIE in South Tyrol case study are also considered a success since the stakeholders agreed to use it. Awareness raising and the successful involvement of stakeholders as well as the investigation of several dimensions of vulnerability was the achievement of the Cologne case study (UNU/UNIDO).

Challenges and limitations of the case studies

As far as the use of the framework is concerned most case studies did not have a problem in using it. However in the Portugal case study a difficulty was the guarantee that the use of the framework really produces answers for the stakeholders. Moreover in the same case study a difficulty was to integrate the vulnerability component in the risk equation and the weighting of the indicators. Regarding the development of the indicators and the implementation of the methodologies, data availability was the most important drawback of the partners in the implementation of the case studies. Partners had to face challenges regarding the acquisition and use of data on old buildings in Florence, heat waves in Italy, damage following alpine hazards in South Tyrol and mass movements in Portugal, robust indicators of social disparities in Barcelona and social indicators in South Tyrol (in that region's flood case study). The time restrictions and the workload was also a drawback especially in case studies such as Barcelona and Florence. In case studies with a very strong stakeholder involvement the lack of participation and awareness as well as bureaucracy and limited access was also a disadvantage (South Tyrol flood study and Florence case study). FLUP in Portugal and UNIFI in Florence faced the additional challenge to make the results relevant to the stakeholders and to transform academic results into practical applications. As far as the development of indicators is concerned UNIDO/UNU had to face the challenge of defining indicators that are both relevant for our academic approach and practically implementable. All these challenges lead to limitation and uncovered issues in each case study. For example, due to lack of data UNIVIE did not manage to expand their methodology from debris flows to more alpine hazards such as snow avalanches and landslides. EURAC in the same case study failed to involve the attitudes of individuals and businesses that were only indirectly affected. Time restriction also limited the testing of methodologies in different places in Europe or the application for different hazard types.

Lessons learnt from the involvement of stakeholders

The involvement of stakeholders was a very significant part of the project. The stakeholders were not only the receivers of the results of our research but they were involved in the early stages of the project and assist its implementation with providing data, their feedback on the methodologies and useful information from their experience.

Apart from the feedback on the framework (see Chapter 2) the stakeholders provided feedback on each case study which was in general very positive. Most of the stakeholders agreed to test or even use the products of our research or the results of the case studies and integrate our methodologies. In more detail, in some cases for example in Portugal (FLUP) the stakeholders suggested that the MOVE methodology was closer to reality than the models that were available for them to use until now. The stakeholders also got involved in the development of the methodology giving feedback based on their own experience. For example, in S. Tyrol (EURAC and UNIVIE) they intervened in the

implementation of the methodology. In London, KCL developed the indicators for its risk management index in collaboration with stakeholders, who used the index to assess their own practices and emergency procedures. Although most local level stakeholders found the framework difficult to understand, government level risk managers commented on its usefulness in breaking down the conceptual components of vulnerability for them. For example, in South Tyrol (UNIVIE), the stakeholders gave a very positive feedback as far as the methodology is concerned; however, they discouraged the partners to apply the methodology to elements at risk other than buildings (e.g. infrastructure, agricultural areas). In some other cases (e.g. Barcelona) the stakeholders were willing to use the results of the research but they were not willing to integrate the methodology. In Florence (UNIFI) the stakeholders found the study (Health System response) very interesting but they failed to understand how this study could be directly useful to their work in planning and usage of resources.

However, the integration of the stakeholders in the implementation of the project was not always easy. Some partners had to face problems such as difficulty in accessing institution, bureaucracy, shortage of personnel and restricted budgets. In Cologne for example, there was a difficulty not only reaching the right stakeholders especially when they are not coming from the local authorities. Motivating the stakeholders was also sometimes difficult given also the time constraints. In the case study of Cologne the involvement of the stakeholders required twice the time the partners allocated to it. There was often a lack of common language since some things were presented to them in a very academic way which was difficult to understand. Apart from this there was also a language problem since not all the terms were directly translatable form English to the local language.

Future improvements and developments

The partners appear satisfied with the implementation of their methodologies and the final results. However, due to mainly time constraints a number of aspects were not thoroughly investigated or results and methods were not validated. In more detail, a number of partners would expand their methodologies towards different directions if they had more time. For example ZGIS would investigate more the indicators regarding resilience and the relationship between lack of resilience and susceptibility. CIMNE on the other hand would undertake more research regarding elements of the capacity to anticipate and the capacity to cope. Some partners wished for more time for data collection in order to raise the amount of data used and thus the reliability of the results (UNIVIE) or even use different methods (e.g. remote sensing) to improve the quality of data used (CIMNE). Better quality of data would be also a basis for a more reliable scenario in the case of UNIFI. The lack of time was a constraint for most of the partners such a EURAC that would have included single interviews, organized their stakeholder workshops better in order to include an information session before the discussions raising in this way the level of knowledge of the participants. More time would have also given EURAC the opportunity for a better splitting of groups in smaller groups according to e.g. hazard zone. KCL would have benefited from greater response rate and interaction from private water provision companies in the drought case study. Given more time, some partners would have applied the same methodology for different scales (e.g. FLUP, CIMNE) or to different places (UNIVIE, UNIFI). UNIDO/UNU would like to work further with the stakeholders on the reduction of vulnerability and also work more on the ecological dimension. A very important point of improvement would be a feedback loop after the fist results of the case studies and the possibility of the case studies to be more connected to each other, learn from each other and integrate their experience. More time for the overall project could also improve the discussion and outcome of the generic framework and the glossary at the beginning of the project.

The future developments that are proposed concern the project itself and the different methodologies used in the case studies. For example the framework could be improved following the recommendations of stakeholders and experts but also some of its elements such as adaptation and its relation to resilience and risk governance could be more developed. As far as the project itself, is concerned, the results of MOVE, the framework the individual results of the case studies and the knowledge acquired during the project regarding vulnerability should be used in order to strengthen and improve risk assessment in Europe.

Conclusions

MOVE enabled the shift of emphasis from hazard to vulnerability. The project was successful in bringing together stakeholders and academics and raise awareness of the issue of vulnerability. Adopting a more holistic, transdisciplinary approach MOVE produced a model for interaction between researchers and stakeholders. MOVE tailored scientific work to practical needs and made practitioners aware of the benefits of scientific work which was made available. Existing methodologies for assessing vulnerability were refined and new ones were developed and tested in different areas in Europe bringing interesting and useful results. Knowledge was acquired in various vulnerability issues and on how vulnerability can be captured in different dimensions. The success of the project lies on the fact that it clarified what vulnerability means in theoretical, practical and operational ways.

It developed specific research instruments designed to identify, characterise and measure vulnerability in the field in Europe. Moreover, it tackled the common elements of vulnerability in different parts of the continent. The project also considered vulnerability from the opposite side--that of resilience and coping capacity. MOVE created and disseminated methods and procedures that will be directly useful in efforts to reduce vulnerability to natural hazards in Europe by formulating policy, directing development, designing protection measures, allocating funds, consulting stakeholders, and encouraging informed public debate on safety and security in Europe.

The Generic Framework was definitely an achievement of the project. The framework defined the major pillars of vulnerability. It captured the different aspects and dimensions of vulnerability encompassing at the same time not only fragility and susceptibility but also the ability to cope and adapt in changing environmental conditions and shocks. MOVE developed a methodology that helped us learnt more about vulnerability, and the dynamics between its parts. Through MOVE knowledge was gained on topics that have not been researched in depth before such as the vulnerability to heat waves. Coupling processes were emphasised, for example the influence between fires and human behaviour. Data needs connected with vulnerability indicators were identified and innovative ways of acquiring the required data were proposed. New methodologies were developed and the link between quantitative and qualitative approaches was considered. The incorporation of social learning and adaptive behaviour in vulnerability assessment emphasized the role of human actors in shaping hazard risk.

The case study applications brought successful results and due to the involvement of stakeholders awareness on vulnerability issues was strongly raised. The stakeholders in general accepted the framework but whether it will be implemented it is still questionable. There is definitely a communication problem between the stakeholders that partly find the framework complex and its

practical value difficult to understand, and the academics and researchers who often fail to 'translate' academic results into practical applications. The Stakeholders requested to be provided with a set of guidelines for using the framework. However, this gap might be closed with the compilation and distribution of the MOVE Manual. A lesson that definitely has been learnt from MOVE is that there is a need for common language and reinforcement of the relationship between academics/researchers and practitioners/stakeholders. MOVE definitely bridged partly this gap but also highlighted remaining aspects that have to be solved.

MOVE placed emphasis on the importance of adaptation and risk governance processes. However, the issue of 'risk governance' has to be strengthened. 'Risk governance' as the experts also commented should not be only an element of the framework but the overall frame where the framework is included. Since risk governance is 'the totality of actors, rules, conventions, processes and mechanisms concerned with how relevant risk information is collected, analysed and communicated and management decisions are taken' (IRGC, 2005) its role ought to be more central in the project.

One of the expected impacts of the project was to consider vulnerability from the opposite side, that of resilience and coping capacity and to develop relevant indicators. Indeed, a number of case studies investigated these specific aspects; however, they were confronted with the problem of data availability. The problem of data availability was common for all the partners of the project but it was especially stronger for the ones that were dealing with social vulnerability and resilience. In some cases the problem is not that the required data do not exist but also that although they exist they are not available (e.g. EURAC heat wave study). Data availability restricted in most of the case studies also the validation procedure that in some cases was not possible.

There were time-constraints since the implementation of the methodologies was often time consuming. For this reason there was no opportunity to test the transferability of the methodologies not only to different places in Europe but also to other hazard types or elements at risk. There could have been a feedback loop following the first results to connect the case studies in order to share experiences and learn from each other. However this was not possible due to time restrictions.

Although uncertainties are an intrinsic part of any attempt to assess vulnerability due to the stochastic aspects of natural build and social environment, it was only partly addressed in this project. The stakeholders showed an interest in uncertainties but there was only one case study were uncertainty analysis was carried out.

Potential Impact:

Socio-economic impact and implications of Project MOVE

The public utility of the MOVE project can be summarised as follows:-

1. The project has clarified the current state of the art in the assessment of vulnerability to natural hazards and climate change, with special emphasis on the European dimension, and with special attention to the applied dimension of utilising assessment measures in the field.

2. MOVE has provided a robust and clearly intelligible theoretical framework, so that stakeholders can see and understand the relationship between the parts of this complex problem. The framework has been explained in deliverables in detail, in synthesised form and as a single diagram.

3. MOVE made it clear that vulnerability can only be thoroughly understood by employing an interdisciplinary methodology that concentrates on the relationships between the different aspects of the problem; for example, between the physical vulnerability to hazards and the built environment and the social vulnerability of human communities.

4. The MOVE Manual of Vulnerability Assessment can be used by stakeholders to determine how to resolve their own problems in this field. It offers a wide choice of methods, with evaluation of their utility under particular circumstances. Clarification of the use of methods can be found on the accompanying Handbook of Vulnerability Assessment, which uses the MOVE case studies as illustrations of the methods described in the handbook.

5. The deliverables of MOVE, especially those regarding methods and frameworks, were compiled after listening to and taking into account the views and opinions of stakeholders from public administration, emergency management, business, policy formulation and technical services. They are thus based on a consensus about what is needed in this field in Europe.

As noted throughout MOVE, and in many of the project's deliverables, vulnerability assessment and reduction is the essence of risk management. MOVE developed new, practical means of assessing it and ensured that these were viable and productive in as wide as possible a range of European settings. Partners therefore expect practitioners to make use of the methodology in future vulnerability assessments, which will provide the key to disaster risk reduction in Europe.

The beneficiaries of MOVE worked closely with local stakeholders. These included river basin planners and managers, city administrators and planners, emergency service directors, hospital plant directors, and many others. Not only were these people made fully aware of the products and benefits of the MOVE approach, they were also encouraged to disseminate the information and public deliverables to other potential stakeholders.

Vulnerability reduction is the key to saving lives, money and livelihoods in areas of Europe that are particularly affected by natural hazards and climate change. Improved methodologies for understanding and assessing vulnerability are essential to its reduction. Hitherto, the excessive emphasis on measuring, monitoring and mapping hazards has caused vulnerability to be neglected, but hazards are often considered to be little more than the trigger of a set of processes governed by vulnerability, which is the principal determinant of how much harm will occur in disasters.

Like other parts of the world, Europe is slowly effecting the transition from management of hazards to more comprehensive programmes designed to create resilience, or robustness in the face of disaster risks. Current programmes place much emphasis on applied research into the means of creating resilience in society, its institutions, communities and businesses. However, this could not be achieved without a precursory period in which there was an intensive focus on vulnerability, the obverse of resilience. MOVE is one of several European and also worldwide projects that have contributed to improvements in the understanding of vulnerability and have therefore laid the basis for developing better resilience strategies.

Dissemination Activities and Stakeholder Workshops

The hazards research community has taken an increasingly strong interest in processes that involve stakeholders in the reduction of vulnerability and corresponding improvement of resilience. The main target group of the MOVE stakeholder workshops was "individuals or organisations with a defined interest in the matter at hand (i.e. they are identified actors, including decision makers and people who are at risk, and who have a direct interest in the subject of study" (from the MOVE definition of stakeholders). These are representatives of organisations that utilise research and have a direct interest in its outcome and in the phenomena considered. They therefore include decision-makers and people who are immediately at risk of hazard impacts.

The purpose of stakeholder involvement in the MOVE Project was to create and maintain a dialogue with beneficiaries and interested parties. The process enabled stakeholders to validate the general conceptual framework and test the applicability of methods proposed by the project. It permitted information to be disseminated and feedback collected.

The first step of involvement was to identify target groups of stakeholders. Besides colleagues and project partners, the main beneficiaries are end users with a direct interest in what the project has to offer. These include public administrators, urban and regional planners, disaster and risk managers, educators, professional providers of specific services (such as environmental monitoring) and scientists in research institutes. The second step was to convene meetings, workshops and focus groups with the stakeholders, having supplied them with adequate briefing materials. Where required, the meetings were complemented with field visits to appropriate sites.

Generally, the technical level of background material and discussion needed to be tailored to the level of technical understanding and the specific interests of the participants. This did not mean that material was "dumbed down" or oversimplified, but merely that it was presented in a manner that avoided unnecessary technical density and academic or scientific jargon.

Studies show that there are often huge discrepancies in how people perceive hazards, risks and therefore vulnerabilities. Clarity and lack of ambiguity are therefore essential features of good communication, along with understanding the fact that information must be couched in terms that are not too context-specific to be intelligible to people with different backgrounds. Stakeholders should be accepted as partners in the process of risk communication, which should be carefully planned and monitored (the message may need to be adjusted if it is not effective). Honesty and openness are to be preferred, as is the use of credible sources.

MOVE involved stakeholders and consulted them systematically in order to understand their needs and enable the project to draw attention to the practical value of its methodologies. There were three

main benefits of this approach. First, informing stakeholders about the complexity of the hazard leads to better awareness of the problem. A workshop offers the platform for exchange of opinions between different stakeholders which often do not, or only little, communicate about a common problem. The exchange between the stakeholders results in a better understanding of what the position of the other stakeholders is and what concepts to prevent disaster exist. The second main output is a clear position towards a common generic framework of how to deal with risks and hazards. Each workshop validated the framework against the risks that the stakeholders had to deal with and came up with a standardised output. Thirdly, the sensitisation of the stakeholders concerning the methodologies, tools and measurements enhances their knowledge of risk mitigation and preparedness.

In summary, the benefits conferred by MOVE are as follows.

A standard approach designed to improve the estimation and measurement of vulnerability. The MOVE project adopted a broad approach, and brought together researchers with various professional and geographical backgrounds. It elaborated standards and techniques for vulnerability assessment to be placed immediately in the service of risk management and mitigation throughout Europe. The findings of the project can serve as clear guidance for policy developments at different scales. The production of the Manual as a comprehensive and user-friendly guide fills a gap in the international level of guidance in this field.

Improved risk estimation. Given the probable impact of climate change upon the continent, as well as the increasing effects of natural hazards, MOVE fulfills a need for standards and guidance in estimating vulnerability as the critical component of risk. It therefore helps bring the problem under control.

Better promotion of disaster resilience. MOVE has created and begun to disseminate methods and procedures that will be of direct use in efforts to reduce vulnerability to natural hazards in Europe by formulating policy, directing development, designing protection measures, allocating funds, consulting stakeholders, and encouraging informed public debate on safety and security in Europe. The European dimension of MOVE is well demonstrated in the breadth of participation, the choice of case studies, the strong emphasis on comparative approaches, the breadth of contributions to general and generic methodologies, and the wide geographical coverage of the project.

Copies of the MOVE manual and handbook have been printed and disseminated as widely as possible in hard copy and pdf form among potential users throughout Europe.

List of Websites:

The public website of MOVE can be consulted at http://www.move-fp7.eu.

Further details on the project can be obtained from the former project admninistrator, Prof. David Alexander, Global Risk Forum GRF Davos, Promenade 35, CH-7270 Davos Platz, Switzerland (tel: +41 81 414 1616, fax: +41 81 414 1610, email: david.alexander@grforum.org), and the scientific director of MOVE, Dr Jörn Birkmann, United Nations University Institute for Environment and Human Security, UN Campus, Hermann-Ehlers-Strasse 10, 53113 Bonn, Germany (tel: +49 228 815 0208, fax: +49 228 815 0299, email: birkmann@ehs.unu.edu).