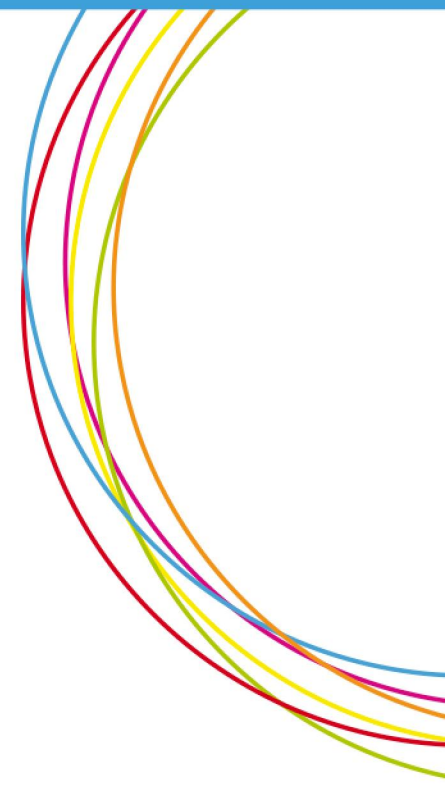


enhance
Partnership for Risk Reduction



ENHANCE

Enhancing Risk Management Partnerships
for Catastrophic Natural Disasters in Europe

Grant Agreement number 308438

Deliverable 2.2: DEVELOPING A RESILIENCE FRAMEWORK

Authors: Laurence McLean (CRED), Debarati Guha-Sapir (CRED)





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Author(s)	LAURENCE MCLEAN, DEBARATI GUHA-SAPI
Organization	CRED, CENTRE FOR RESEARCH ON THE EPIDEMIOLOGY OF DISASTERS, SCHOOL OF PUBLIC HEALTH AND SOCIETY, UNIVERSITE CATHOLOQUE DE LOUVAIN, BRUSSELS, BELGIUM
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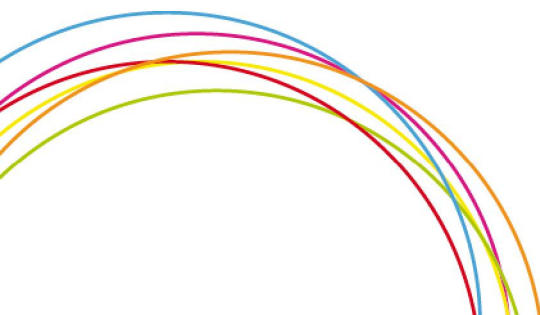




Summary

This report presents a case for sustained engagement with the increasingly fashionable term of resilience, which has experienced a meteoric rise in recent years, especially within the field of disasters studies. Theories, such as resilience, denote a 'guiding light' on practical measures such as mitigation, prevention, response and recovery. Resilience is a powerful descriptor, able to forge interdisciplinary collaboration and facilitate stakeholder partnership development. Yet, coupled with its popularity is a degree of confusion resulting from the sheer multitude of related interpretations. This report argues that rather than needing a sea change in approach in dealing natural hazard risk, Disaster Risk Management (which has a strong focus on resilience building) and specifically risk methods and assessment, are well-positioned as effective tools for promoting and building resilience to disaster events.

Central to the ENAHNCE project are Multi Sector Partnerships (MSP's). It is proposed that such partnerships can be innovative, able to link learning processes with a range of resources, and helping to create a more fertile environment for institutions and organisations with different backgrounds and expertise to engage in inter-organisational cooperation to increase resilience. In order to start empirically testing, some issues will be highlighted to provide guidance to case study intent on developing indicators and attempting to measure them within their respective contexts. In this respect, some characteristics of stakeholder partnerships are outlined to guide context-specific research into increasing resilience and to stimulate future partnership activities.



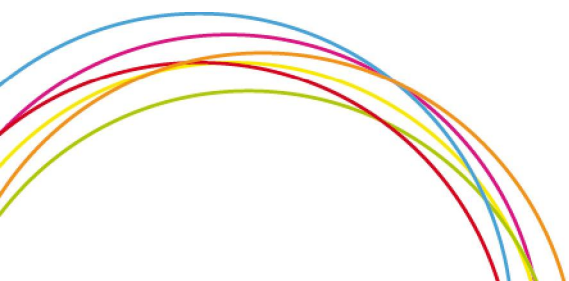
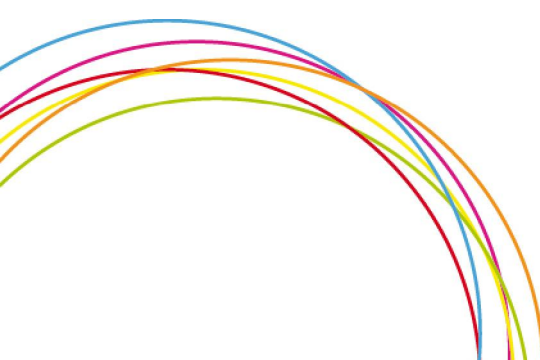




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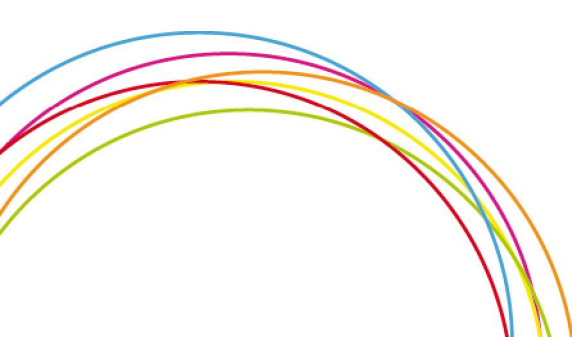
1 Introduction

This D.2.2 working paper aims to outline a generic framework of resilience to the threats posed by natural hazards and extreme disaster events. It will include an overview of the different resilience perspectives, some identified components of resilience, and why the concept is as useful as 'guiding vision' or 'entry point' to disaster research. This draft report will serve as key resource in development of the Ten Enhance case studies, found in WP7. It constitutes an attempt to guide case studies who intend to analyse indicators and measure their effectiveness. In the context of Multi Sector Partnerships (MSP's) in this process, attention will be given to the cross-cutting thematic area of governance, in which its sub components are presented.

As a response to predicted trends in more extreme weather events (SREX 2012), disasters events being particularly economically damaging in most recent years (EM-DAT, 2013), and uncertainties posed by Global Environmental Change, the concept of resilience has increased in popularity and is now framing thoughts on sustainability. Its emergence in natural hazards and disasters discourse can be branded as an deliberate strategy to tackle the above challenges through acknowledgement of inherent uncertainties associated with the management of risk (Berkes 2007; Klein et al. 2003; Kuhlicke 2010). The recent Intergovernmental Report on Climate Change on climate extremes has reiterated the need to *increase resilience* within disaster risk management, in context of being unable to fully eradicate risk (IPCC.2012:2 our emphasis). This report revolves around the notion that due to the intrinsic relationship between risk and resilience approaches, strategies can be built upon a foundation of effective risk assessment and risk management, as this illuminates on resilience itself (Mitchell and Harris, 2012).

Yet resilience, despite its prolificacy, lacks clarification on how it can be measured, sustained and enhanced (Klein et al. 2003; Manyena 2006) Indeed, such problems have been underpinned by disharmony regarding how the term is defined, or how it can be applied in policy and practice (O'Hare & White 2013). Furthermore, there is an increasing need for clear delineation and analysis on the multiple conceptualisations of the term which characterise the literature base.

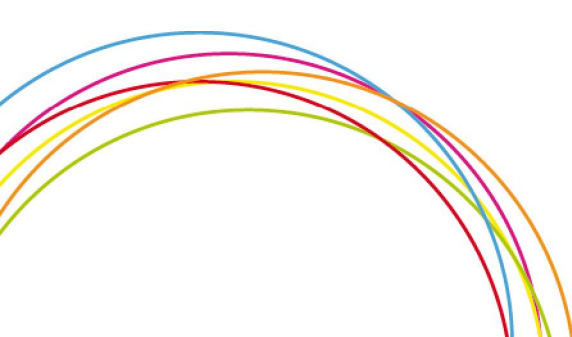
Given differing scales of analysis, time frames, and conceptual orientation, broad applicability of the framework is desirable to maximise its usefulness and allow it to be adapted to specific case study needs. However, to achieve this generic position it would be unwise to present (and ultimately construct) a universal version. Rather an explanation of the different aspects of resilience allows case studies to decide on the relative pertinence to their research context and objectives. Thus, the key task is to illustrate a theoretical frame that targets the core fundamentals and parameters of resilience. The applicability of the report, therefore, can extend to non-European contexts including developing countries.





The framework is unique in its focus on how guiding empirical study to adopt a risk management approach to building resilience. It considers MSP's, as both a governance innovation and indicator of resilience itself. The report will draw upon the concurrent European Union funded project, emBRACE- 'building community resilience to catastrophic events in Europe' which has synthesised various resilience concepts and indicators, and explored the terms historical development(EmBRACE 2012)

The report is organised as follows. Firstly, the scope and objectives are outlined (section 3), followed by a non-exhaustive review on the origins, underpinning key concepts, (including some definitions), with the latter half focusing on modern perspectives on resilience (section 4). In the discussion section (5) resilience is furthered characterised with a discussion on vulnerability (5.1), on its strength and character (5.2) from this, the discussion moves to issues surrounding indicators, measurement, and alignment with a risk management based approach (5.3). The penultimate sub section (5.4) considers the role of Multi Sector Partnerships (MSP's (illustrated by figure 3). Lastly, some key messages and conclusions are presented (Section 6).





2 Review of origins, concepts and perspectives on resilience

The resilience concept has garnered intense interest in recent years. In light of this, and the rapidly-growing literature on resilience, sections 4.1 & 4.2 provide some clarity on how the concept has evolved to give depth and continuity to modern understandings and definitions

2.1 Human psychology¹

Although there is evidence of resilience initially in mechanics (Alexander, 2013) and then in medicine (Pfeiffer, 1929), literature indicates resilience largely gained momentum through Human Psychology. Early notions of resilience are attributed to psychology scholars in the 1950's and 1960's, notably Norman Garmezy, Emmy Werner, and Ruth Smith, who collectively forged a change in research focus to strengths rather than deficits (Johnson & Wiechelt 2004). Such work would traditionally centre on measuring qualities that at-risk individuals possess. During the 1970's, it became a fashionable descriptive term for children with varying levels of vulnerability to traumatic events (e.g. abuse, bereavement, disasters). It was generally used to explore factors that influence change and transition back to a 'pre-impact' state.

In the context of resilience today, early definitions were distinctly conservative. Present-day physiological research on resilience has shifted focus. Now, less emphasis is given to outcome (protective) factors relating to human self-capacities, and more towards the inclusion of the dynamic (protective) processes that occur within the social and ecological environment at multi-interdependent scales (EmBRACE 2012). This has, in effect, deepened our understanding on the connections and linkages that influence a person's resilience within a system context.

From this holistic framing, the concept further evolved revealing some interesting contentions which are highly relevant to risk management framed approaches to resilience. Past studies have put forward a link between resilience, a shock event, and resultant processes of human recovery and growth (Karanci & Erkam 2007). This feeds into popular understandings of the term, for example, a resilient person exposed to risk is flexible and able to 'bounce back' or possess so called 'bounce forward ability' (Manyena *et al* 2011). However some challenge this standpoint and suggest that an individual's recovery or growth post-disaster only occurs after a period of decline, associated with sub threshold signs of physiopathology symptoms. This interpretation frames a resilient individual is able to persist, without a need to grow as they are quite naturally (relatively) unaffected. In effect, they are

¹ As noted by Alexander (2013:1263), the origins of resilience were actually originated in the discipline of mechanics, but for the sake of clarity and relevance to case studies, discussion of this was omitted. (e.g. "The first serious use of the term resilience in mechanics appeared in 1858, when the eminent Scottish engineer William J. M. Rankine (1820–1872) employed it to describe the strength and ductility of steel beams")





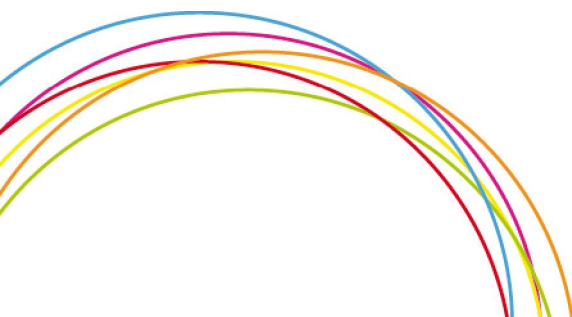
able to maintain stability and health post disaster, without external assistance (Bonanno 2004; Bonanno 2005). Ideas of recovery, improvement and growth do not align with such interpretations of resilience. Two thus discrete post disaster physiological health trajectories have been identified, both of which have been labelled as 'resilient'.

Are these just different manifestations of resilience, as both appear to be positive reactions to shocks? In effect, they are outcomes arising from different types and blends of individual psychological factors such as experiences, personality, and emotions. It seems that further research to analyse these divergent pathways and their relationship with understandings of resilience could foster better theoretical coherence, both within and beyond the field human psychology.

Theoretical tensions aside, some risk factors influencing an individual capacity to be resilient is starting to emerge. A recent a psychological resilience systematic literature review has highlighted two focal points for tailoring risk management policy. It firstly highlighted the differential impact of disasters on females, who are generally less resilient in a post disaster landscape. It depicted, furthermore, that an individual psychological resilience can also be shaped by management processes, where a correlation between the degree of social support experienced during a shock phase, and the level of psychological resilience measured after an event was observed (EmBRACE 2013). While these findings are positive, data collection was primarily extracted from western countries thus the questions arises of would similar risk factors be observed in more socio-culturally diverse contexts? In sum, disasters-psychology focused on resilience can provide important insights to governance structures, institutions, potentially creating a focal point for MSP's, particularly those focus on shaping post ante management actions (on recovery and rehabilitation).

2.2 Socio-Ecological Perspectives and the Influence of Hollings (1973)

As noted by Pelling (2011), contemporary framing of resilience in climate change and hazard management communities are predominately rooted in socio-ecological systems (SES). In this respect, while mechanics, medicine and later psychology were the forerunners on resilience, literature points to the significant contribution of social ecologist Stanley Crawford Hollings (1973). His landmark paper titled 'resilience and stability of ecological systems' highlighted the interconnectedness and complexity inherent to such systems, explicitly drawing on tensions between efficiency and persistence. Importantly, he projected resilience as a 'descriptive' rather than purely normative concept (Blaikie & Brookfield 1987). It is proposed that a "resilience determines the persistence of relationships" in the context of absorbing any change to variables and parameters (Holling 1973:17). A core message, which is a key resilience criterion observed today, is that a disturbance should not cause an alternation of the essential functional characteristics. Additionally, the paper advocated the end of the single or 'well defined' equilibrium theory, rather one which centres itself on non-linear factors of influence that interact dynamically and (re)produce a complex multifaceted system, which contain various dynamic states of equilibrium (Lorenz 2013:8).





However despite this shared origin, within the school of social ecology there are conflicting understandings of resilience, especially in regards to the inclusion of transformation. The majority of contemporary social ecology based framings are preoccupied with resilience as an agent of transition, less concerned with profound system change. However described as 'a fundamental alteration of the nature of a system once the current ecological, social or economic conditions become untenable or are undesirable'(Nelson et al. 2007: 397), transformation is documented in the work of Adger (2000) and Gunderson (2010). Resilience, from this perspective, has 1) multiple equilibria, 2) capable of absorbing change for significant period time 3) has the ability, once a threshold has been surpassed, to transform while maintaining its essential functioning, structures and amenities. In this vein, there has been call to recognise the importance of tipping points to new equilibria (states) as a system interact with external shocks, and to monitor and evaluate such changes when they occur (Renaud et al. 2010).

Over time, four main characteristics of system resilience emanating from the Socio Ecological literature have emerged: 1) the idea of that any engagement with resilience needs the presence of a disturbance or perturbation, and 2) the impact, particularly the effect on functional persistence and ability to absorb and re-organize, in addition 3) having the ability to learn and adapt (Folke 2006) (which includes learning to live with uncertainty) Lastly, 4) building resilience in systems faced with disasters should display opportunities for self-organisation and cross scalar linkages (Berkes 2007: 287-288). Harnessing an ability to re-structure and learn seems especially pertinent in the uncertain backdrop and dynamism of climate change, and can enable risk management organisations to become resilient through the processes of adaptation (Pelling, 2011). Notwithstanding the inconsistent support for idea of transformation, modern understandings reflect the importance of learning mechanisms for adaptation. This, therefore, transcends more simplistic ideas of resistance and maintenance (Brown, 2011).

As shown in **figure 1**, in contemporary setting resilience has developed into distinct perspectives which are orientated different towards varying goals, driven by actors with different views and agendas. All have relevancy to a Disaster Risk Management approach to building resilience. These are: 1) Human Psychology 2) Institutions and Organisations, 3) Critical infrastructures, 4) Social Ecological Systems. Perspectives on Governance (institutions and organisation), and critical infrastructure are the latest additions and were thus not discussed in relation the concepts development, but instead be will outlined below.

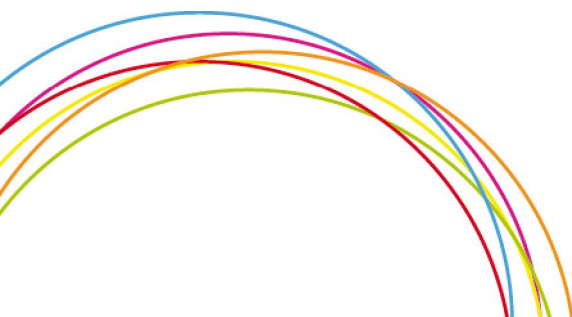




Figure 1. Literature Toolbox. Some key papers on the four established resilience perspectives which serve as a good starting point for case study research.

Although economic resilience, as a perspective/dimension of resilience, is less developed in the literature, voluntary but enforceable partnerships should in theory build economic resilience to shock events (e.g. ex ante financial measures for risk sharing/transfer). It is therefore important to explore, develop indicators for, and empirically test the role partnerships in reducing risk and increasing resilience (see overall guidance deliverable 2.4, section 2.3 on insurance partnership indicators). In this regard, ENHANCE will look to further develop the economic dimension of disaster resilience, and integrate future findings to improve the comprehensives of the overall framework (D2.4).

2.3 Governance and Resilience

The concept of resilience within governance, particularly institutions and organisations, is relatively new resilience dimension, and yet enjoys increasing presence in resilience literature. At the international level, the adoption of the 'Hyogo Framework for Action 2005-2015: Building the resilience of nations and communities to disasters' which pushed the resilience agenda forward in governance circles (e.g. institutions, organisations).

Organisations and institutions that operate within governance structures within different sectors (public, private, & community based) are understood to be rational systems with a clear delineated and well-defined rules, containing relationships created to achieve a single, or set, of specific objectives (Scott 1994), which are generally rooted in the expectations of external stakeholders and members of the organisation. Crucially, they are well-placed in managing hazard risk and primed as agents with resources, knowledge, technical skills to increase resilience.

A resilient path is ultimately constructed from good organisational systems of anticipation, such as planning, risk scenario analysis, and preparedness. As these processes limit the impact by increasing a systems capacity to absorb or accommodate disaster impacts. Thus an important consideration within the case studies is striking an appropriate balance between systems of anticipation (risk assessment methods), and focus on the processes that increase capacity to adapt to uncertainty (e.g. adaptive governance). Such partnerships can



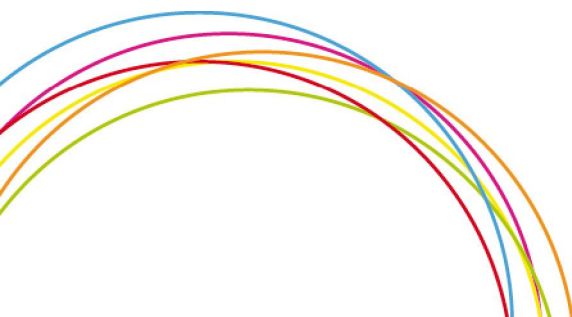


form important bridge between capital resources and modes of learning. They carry the potential improve a range of elements such as rapid negative feedbacks, during a response, or post event to facilitate critical reflection on risk management practices. These collaborative partnerships form the overall objective of ENHANCE, to elucidate on the measurement and development of MSP within DRM, with the explicit purpose of reducing or re-distributing disaster risk, increasing resilience, improve public health outcomes and contribute overall sustainability.

Increasing focus is given to studying institutions, especially how interact and behaviour with each other in context of risk and resilience. Yet due to a dearth of empirical research, characteristics and indicators of the constituents of resilience in risk governance settings remain unclear (Hutter et al. 2011). Some theoretical areas for investigation have been identified, however, and form a useful reference point for research. Governance is generally comprised of multiple institutions from different sectors. Institutions can be defined as a social order characterised by values, procedures, legal and regulatory frameworks, based on both formal and informal rules which members agree upon – which are generally used as means to govern defined groups, communities, individuals (Scott 2008). Given the fluid nature of institutions with dynamic interdependency in daily interactions, scalar classification of macro and micro level can appear misleading; rather institutions are *mutually influencing* each other at different scales (EmBRACE 2012). Although most literature defines institutions as static social construction shaped by a mixture of formal constraints (regulation, laws, etc) and informal constraints (such as cultures, social norms and conventions) recent work has looked to move beyond this interpretation to consider how they *dynamically interact*, and what processes connect their objectives and mutual aims.

An overarching concept to understanding institutions and how they function in the context of threats is a process known as *sense making*. In essence good sense making is able to build a pre-action capacity to ameliorate processes that illuminate on the choices that produce good decision-making with increased awareness of risk. *Sense making*, generally observed at the micro level, increases or decreases the capacity of social agents to adjust to risks and disaster events through mechanisms of learning, interpretation and action (Weick & Sutcliffe 2001). Through enhancing MSP and developing new configurations it is hoped this process can be enabled through linking interests and participation between social agents (risk governance/risk management).

Any MSP needs to be looked at critically, particularly in terms of actor's interpretation of resilience. Are institutions or organisations actually committed to resilience (e.g. is there resource allocation?). To what extent is resilience actually embedded within practices and procedures? If not, how could it become an embedded feature of an institution? The work of Kuhlicke (2010) has suggested resilience represents an institutionalised 'myth'. Thus, crucial to understanding and assessing institutional partnerships is investigate whether resilience





serves to rebrand existing approaches and procedures (which may have been quite effective before) or is discernible different to past measures.

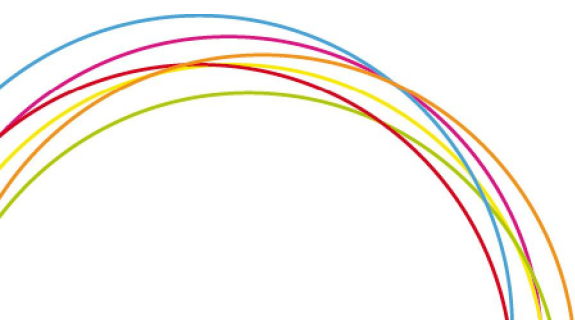
The work in this area has suggested that nuanced perspectives of resilience have not been reflected in policy discourses. In fact, some argue, the term is being used to validate a defensive, business as usual approach, with the intention of securing pre-disturbance human and economic assets (Brown 2011). MSP development should thus be monitored critically to assess performance against typical 'outcomes' associated with resiliency (e.g. is there timely and efficient recovery from a shock). This is potentially a useful perception, allowing 'failures' or areas for improvement to be quickly identified. However, to perceive disaster resilience as an outcome increases the chances of reinforcing traditional disaster management practices, which tend to take a reactive stance orientated towards emergency response (McEntire *et al*, 2002).

Therefore, more critical reflection on this shift in orientation towards resilience in organisations would be useful. Not only this, but also empirically test what resilience really means to organisations. This can ease the process of developing and implementing partnerships, as they can be adapted to in terms of achieving an 'institutional good fit'.

2.4 Critical infrastructures

The development of resilient critical infrastructures (CI's) is essential to ensure modern society continues to function, as key public services, private sector profit, economic growth, population health and quality of life are dependent upon their existence (Boin & McConnell 2007). Yet with climate change and the impact of extreme disasters events, there is burgeoning vulnerability associated with CI. Thus, in this context, focus has been afforded to what are indicators of a resilient CI system, how it could this be achieved, and what factors may inhibit a CI resilience building process.

CI resilience is defined as the ability of system and its components to reduce the chance of failure absorb and accommodate impacts, (dampening any abrupt reductions in performance), and recover in a timely manner (to re-establish the status quo; acceptable performance or functioning, this may of course may highly subjective). According to Hellström (2007), a resilient CI should possess the following attributes: 1) Reduced failure probabilities (probabilistic risk assessment) 2) Reduced impact from shock (e.g. on the infrastructure itself, lives lost, social, political and economic consequences) 3) Timely recovery. CI systems play a pivotal role in critically influencing the disaster resilience of a community or metropolitan area.





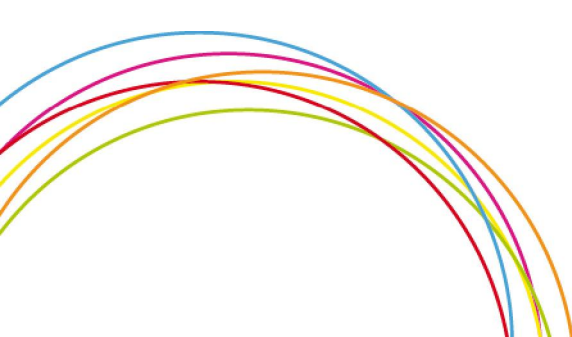
CI is of particular interest for safety geo engineering, urban infrastructural planning, and risk and crisis management. From a geophysical engineering perspective, four requirements have been identified for CI physical and social resilience to disaster events:

- Robust
 - Displays redundancy
 - Resourceful
 - Capacity for rapid response
- (Bruneau *et al*/2003)

When assessing CI resilience there is recognition for a wider holistic picture incorporating the whole system, as CI are embedded within a backdrop consisting of operational technologies, organisations, institutions and social and economic systems. These key dimensions have the potential to form a development framework to embark on case study analysis which is able to investigate CI more closely as a phenomena rooted amongst a range of societal processes. From this, how can we relate these (Governance) institutional and organisational processes to risk reduction and resilience work? How can we better integrate and reconcile quantitative based risk assessment within processes and systems of governance?

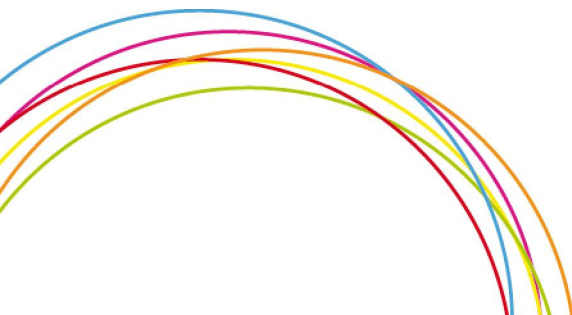
European led governance mechanisms are seen increasingly as important instruments for harmonisation of policy between EU Member states who are actively engaged in the management of hazards. This is being facilitated via binding legislation and sector tailored approaches, all aimed to enhance and build specific infrastructures. Agreement was reached that greater collaboration, communication, consultation, open dialogue, common surveillance and dissemination of good practice would be highly desirable with regards to enhancement of CI resilience. Such European orchestrated approaches may be transferable to other resilience perspectives and to enhance practical risk applications. For example, atmospheric hazards, such as Heat waves, generally have a wide geographical presence and could benefit from greater regional risk management collaboration. In this context, research will be aimed at exploring how improved inter regional partnerships reduced the risk from heat wave events. Furthermore, the ability to assess how much the risk will decline because of such enhanced cooperation could serve as a persuasive tool to policy makers.

One emerging area within CI and resilience discourse involves the process of governance and how they direct strategy and decision-making. Until recently the predominant approach to CI mirrored traditional principles of crisis management, which emphasised robustness through “bouncing back” and being resistant to change. Yet such methods have been criticised for undermining reliability and performance. CI is ostensibly more vulnerable because of inherent systematic characteristics that surround the effect of a range of macro processes, such as liberalisation, deregulation, and privatisation. The work of Bruijne and Eeten (2007:2) adds that a paradoxical challenge exists in this respect: CI’s are highly interconnected (networked reliability) while the overall management of these systems is now more institutionally fragmented, which, it is argued, has served to reduce system resilience.





to shocks. For ENAHNCE, Testing if MSP's are able to counter this trend and increase resilience and reliability, while reducing fragmentation, is key in the context of critical infrastructure such as for flood risk management for the Rotterdam port infrastructure case study.





3 Discussion

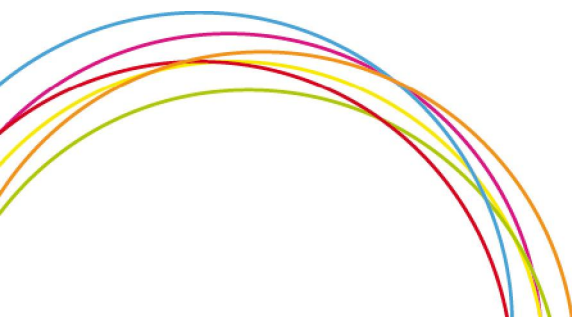
3.1 Resilience and vulnerability

A useful way to define and understand resilience is to contextualise it to other disaster analysis tools, notably vulnerability, which like resilience has gained significant currency in the disasters field (Klein et al. 2003). The relationship between the two concepts has given rise to varied and conflicting debates, with some perceiving it as the 'flip side' in which they are in fact directly relational concepts on a development continuum, i.e. one positioned at the top of the continuum is more resilient and therefore less vulnerable, and vice versa. However, this view appears somewhat simplistic, with recognition building that both terms should be treated in a discrete manner. Key in this is that resilience is distinguished from vulnerability because a person or community can be initially susceptible to impacts and also recover in a timely and efficient manner. Yet, even so, close ties exist between the degree of vulnerability and that resilience as both are rooted in ideas of capacity. Research from *Ecology and Society* and *Global Environmental Change* has deepened understanding on their relationship (Miller et al. 2010) (Gallopín 2006). Specifically, the work of Miller *et al* suggests they are in fact highly complementary, concluding that a mixture of vulnerability and resilience approaches is the most effective means of depicting change in a system, in relation to external shocks.

The applicability of vulnerability to frame analysis will largely depend on the case study characteristics and details. However, two universal considerations remain on vulnerability irrespective of context: 1) Awareness of uneven and diverse vulnerability patterns, which vary across all case studies, interact with disturbance processes (shock and stress) to shape core levels of resilience 2) Vulnerability is a useful proxy on resilience, as high vulnerability suggests low disaster resilience (but not a lack of) as the impact of a shock is likely to be of greater magnitude, thus facilitating conditions that limit capacity for a quick and efficient recovery processes. Clearly vulnerability forms an important resiliency element and should be thoroughly considered when framing the case study analysis.

3.2 Definitions

The Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX) has provided clarity on some key terms, including resilience, all of which are highly relevant to case study investigations (see **figure 2**). This definition is particular useful in framing resilience for a generic framework. It makes connections to specific resilient characteristics through the use of well-established key terms. Anticipate, for example, links to understandings of both realised and future risk, and the role of preparedness and risk transfer. The use of absorb denotes different aspects of resilience. It may relate to critical infrastructure (and its redundancy) ability to handle shocks or at individual or the household scale to describe human psychological resilience to disasters.





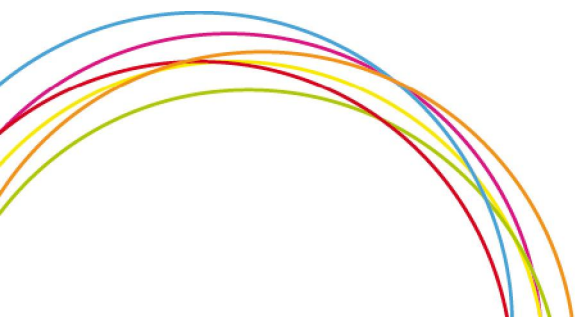
<p>Resilience: The ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in timely and efficient manner, including through ensuring the preservation, restoration, or improvement of its essential basic structures and functions.</p> <p>Disaster Risk Management: Processes for designing, implementing, and evaluating strategies, policies, and measures to improve the understanding of disaster risk, foster disaster risk reduction and transfer, and promote continuous improvement in disaster preparedness, response, and recovery practices, with the explicit purpose of increasing human security, well-being, quality of life, resilience, and sustainable development</p>	<p>Exposure: The presence of people; livelihoods; environmental services and resources; infrastructure; or economic, social, or cultural assets in places that could be adversely affected.</p> <p>Vulnerability: The propensity or predisposition to be adversely affected</p> <p>Disaster risk: The likelihood over a specified time period of severe alterations in the normal functioning of a community or a society due to hazardous physical events interacting with vulnerable social conditions assets in places that could be adversely affected.</p> <p>Transformation: The altering of fundamental attributes of a system (including value systems; regulatory, legislative, or bureaucratic regimes; financial institutions; and technological or biological systems).</p> <p>Adaptation: the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. Source: IPCC, SREX, 2012</p>
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Figure 2. The Table gives the key conceptual definitions in relation to disaster research. All definitions and their associated concepts represent interrelated processes. Their combined influence, in varying degrees, shapes how resilient a system is to a shock/stress/hazard event. Note that the resilience process is influenced by the character and effectiveness of overarching Disaster Risk Management. Source: IPCC 2012

3.3 The character of resilience

There is an abundant supply of literature on resilience, especially on children, but also substantial amount on research focused on how communities deal with atmospheric hazards, and the need to adapt to climate change. Arguably, the concept represents a negotiation of ideas from multiple disciplines including psychology, engineering infrastructure (Hellström 2007) and social ecological systems (Holling 1973)(Folke 2006) Governance (institutions) (Berkes et al; Pelling et al 2008) and disaster risk (Cutter et al 2008) as well as policy circles (e.g. UK national resilience agenda).The resilience concept draws together (in different ways, with a varied focus) a variety of empirical concepts from different research strands, and re-orientates them towards all-encompassing capacity better positioned to reflect the interconnectedness and complexity of systems in the face risk and uncertainty. As result, resilience is a multifaceted concept, inherently adaptable to different uses and contexts.

Due to non-linear feedback, cross-secular processes, and constantly evolving problems, analysis cannot exclusively focus on a single discipline (Lorenz, 2013). Resilience is able to respond to this need offering a holistic approach which recognises architectures and synergies between fields of study, sectors, and actors as well as between the components of the risk management cycle. Thus, a key strength lies in its ability to connect sector of society under a common purpose. In this way, it has been portrayed as a 'boundary object' able to forge communication and sharing of information between actors (Brand & Jax 2007:8), who share a common vocabulary and objective. Some suggest it has the theoretical power to aid





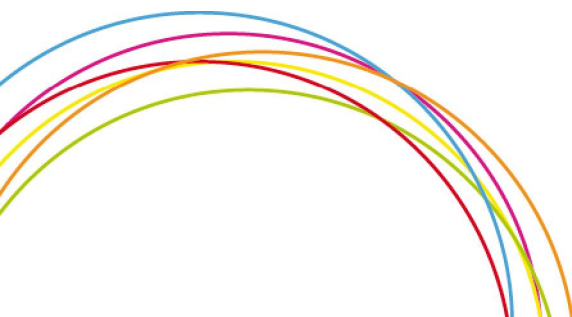
reconciliation between dynamic processes of adaptation and (stable) notions of resistance (Alexander 2013:1273). Resilience is a potent descriptor of objectives, states of mind, body and objects, but concerns are raised when it is escalated to a full scale paradigm or science (e.g. (McEntire et al. 2002) As a recent paper highlights to do this requires the resolution of some key problems:, one of these, as exemplified in the different resilience perspectives (**section 3**), is tendency for resilience to be used in disciplines without suitable reference to how it is deployed in other fields, almost like there is nothing to learnt among branches of science (Alexander, 2013).

Literature converges on it being a complex temporal process involving a range of actors across multiple scales. 'Resilience Renaissance' notes the concept should be envisaged around, and be outcome of, processes of learning, adaptation, anticipation and dynamic improvement to basic structures, mechanisms and functions within environment of hazards and risks (Manyena, 2011)(Bahadur et al. 2010). Emphasis now centres on resilience not as a state but as dynamic set of conditions embedded within a system (Mitchell and Harris, 2012). In this respect, resilience should thus be seen as an explicit and deliberate process, which includes policy, actions, changes to augment capacity at specific scales when faced with single, multiple stress and shocks, including unique and devastating disaster events (Manyena 2006). The aforementioned does raise the question, given that resilience is embodied as a complex temporal process, how does one go about measuring it?

3.4 Measuring Resilience and aligning risk (Management) and resilience

What can indicate resilience to shocks, change, and herein the lack of? An indicator, as defined by Freudenberg (2003), is sourced from either (or both) quantitative or qualitative data produced from observed facts that decipher the complex reality of a situation. The literature on resilience shows that for some dimensions quantitative indicators tend to be used, whereas in psychological resilience qualitative data is the primary method. Most indicators are contextualised to a specific extreme phenomenon or sometimes a range of hazards types. Although ENHANCE case studies generally have a focus one particular hazard, certain indicators may provide a window on ameliorating resilience to multiple hazards. Furthermore, indicators may be developed that are solely designed for a sub hazard e.g. urban pluvial flooding, or all other indicators may be appropriate for broad application to range of flooding events (fluvial, pluvial, reservoir and coastal).

Having an awareness of these indicators is important as they allow us to find goals that can shape guidelines for resilience building strategies. Also, generation of indicators adds empirical evidence base to validate policy decisions, and to help allocate often scarce resources (Cutter et al. 2010). Yet empirically testing and operationalising resilience is challenging task. However, an important first step is the systematisation of the components of resilience sourced from the literature allowing the contextualisation indicators and criteria.





The EmBRACE (2012) project has made a start in developing a set of robust criteria to measure resilience. As part of this, it has systematically trawled the literature in an attempt to draw out the main components of resilience - which are presented below:

Governance (actors, institutional arrangements and organisations) 2) Education, Research, Awareness and Knowledge 3) Information and communication 4) Culture and Diversity 5) Preparedness 6) Response 7) Protection 8) Exposure, Experience and Impact Severity. 9) Resources 10) Health and well-being/Livelihood 11) **Economic** 12) Adaptive capacity 13) Coping Capacity 14) Innovation and Capital 15) Infrastructure and Technical.

Of particular importance to developing MSP is the area of governance, which is the overarching theme underpinning all other resilience components, representing a crucial area for all case studies. From this platform, risk partnerships well placed to have multiple influences on a range of resilience processes, especially with regard to managing ambiguous and uncertain risks posed by climate change, and enhancing all facets of DRM cycle of activities. The various sub components are important to ENHANCE, as these processes shape the effectiveness of DRR and Governance, and may represent indicators of MSP's.

<ol style="list-style-type: none"> 1. Accountability 2. Adjustment 3. Appraisals 4. Advocacy 5. Coordination, 6. Degeneracy 7. Flexibility 8. Participation, 9. Functional 10. Heterogeneity 11. Plasticity/redundancy 12. Support 13. Relationship 14. Responsibilities 15. Voluntarism 16. Autonomous and interdependent 17. Organizational capacities 18. Independent 19. Organized 20. Structural Measures 21. Motivation/Incentive 	<ol style="list-style-type: none"> 22. Partnerships 23. Policies and Planning 24. Legal and regulatory systems 25. Policy and planning 26. Priorities and political commitment 27. Regulated 28. Involved 29. Insurance 30. Structures/ 31. Network and Connected 32. Management 33. Integration with development
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Figure 3, The resilience governance components, critical for examination and development of MSP's (Taken from a systematization of literature) (Source: EmBRACE, 2012)

Rather than approached in a normative manner, the combinations of measures to empirically test resilience tend to be based on data availability (ibid, 2012), as opposed to best available evidence which serves to limit data quality and findings. In addition, caution must be given in using data extracted from measuring resilience at particular (spatial and/or temporal scale), as results are not necessarily transferable. For example, the up-scaling of physiological resilience to a community level represents one challenge, as does defining the

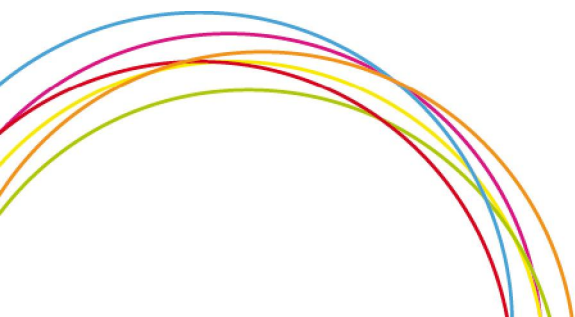




boundaries of a social system. Herein, resilience and managing risk converge in that they are both entirely context-specific, which makes systematic measurement and evaluation thus very challenging as resilience related capacities are rooted in heterogeneous contexts. But such problems are necessary, in the sense that clearly defined spatial and temporal constraints are fundamental to investigating resilience, irrespective of which disciplinary perspective is adopted.

Building a systematic approach to multiple hazard risks is of critical importance. Risk management, which encompasses a board range of devices: risk reduction, risk transfer (through economic instruments e.g. pooling funds), preparation (including specifically for catastrophic and surprising events), as well as emergency response and recovery, is well-positioned as important method in driving towards a more resilient future. A risk based (including risk management and assessment) approach fundamentally resonates with resiliency, both approaches stress the need to: 1) assess and enhance capacities. 2) Explore options for dealing with uncertainty, dynamism and the unforeseen; this includes the ability and willingness to be proactive (Mitchell and Harris, 2012). Moreover, both have holistic frames as they aim to develop systems perspective at multi scales of inquiry. Therefore, systems proficient at managing hazard risk and also likely to emerge as resilient to shocks and stress (Ibid, 2012). As with resilience, a risk based approach centred on good management requires an expansion and diversification of options of a system to meet unexpected challenges. Underlying this process is work to enhance institutional and governance capacities, which are crucial to enabling such diversification to occur. ENHANCE see MSP being key to expanding such capacities and improving such performance. A case in point is public health. To better manage the predicted increases in mortality and morbidity as result of climate change, current programmes need modification and new initiatives are required which integrate local factors such as socio economic and built environment into preparedness and emergency response (Ebi, 2011). This carries the potential to fundamentally improve climate-sensitive outcomes (e.g. in relation to Heat stress).

Due to it drawing upon established concepts derived from practical experience, measurement and building of resilience through a risk management approach is auspicious, more accessible, and resonates with policymakers and practitioners. It is not, therefore, surprising that risk management based approaches have gained some traction as it represent a simpler frame from which to assess disaster resilience. Some general concerns have been registered, however. Such approaches tend to be temporally short, focusing on systems capacities and functioning, rather than investigating processes of transformation and change (Silva Villanueva, 2011:7). From this it is important to ensure that orthodox management rationalisations do not cloud or misrepresent work to build resilience. Concerns of this nature were explored in Governance section (4.3) with regards to how the concept may have become institutionalised. Both discussions led to an important question:

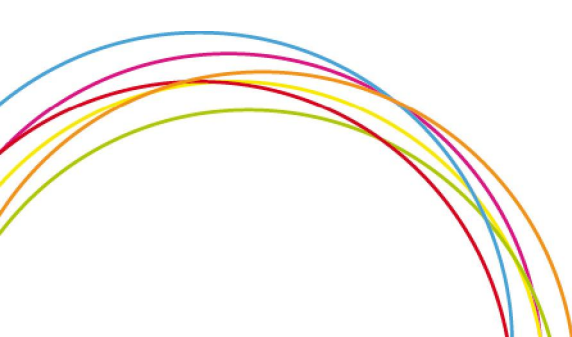




How do we better adapt social systems (e.g. organisations and institutions) who are engaged in hazard risk management to better accommodate nuanced interpretations of resilience?

Notwithstanding the above concern, progress has been made in developing a risk management frame to analyse and measure resilience. Based on a methodology consisting of experience, good practice and meta-analysis, a set of defined indicators to measure community resilience have been developed. Jonathan Twigg (2009) has outlined some resilient thematic areas which include key characteristics: 1) Governance (e.g. accountability, participation, partnerships) 2) Risk Assessment (e.g. vulnerability assessment, hazard and impact data) 3) Knowledge and Education (e.g. public awareness) 4) Risk Management and Vulnerability Reduction (e.g. Health and well-being, planning and financial instruments) 5) Disaster Preparedness and Response (e.g. organisational capacities and co-ordination, emergency response and infrastructure, and early warning systems)

Operationalization table: the following offers a structure in which case study can develop indicators to test resilience, and correspondingly to measure if indicator exists in practice, or indeed it may have a certain criteria to be effective in part or at all (e.g. Clearly through applying a standardised method for describing comparison then becomes possible. The following examples are to showcase how case studies can systematically investigate resilience, making future quantification of the concept possible.



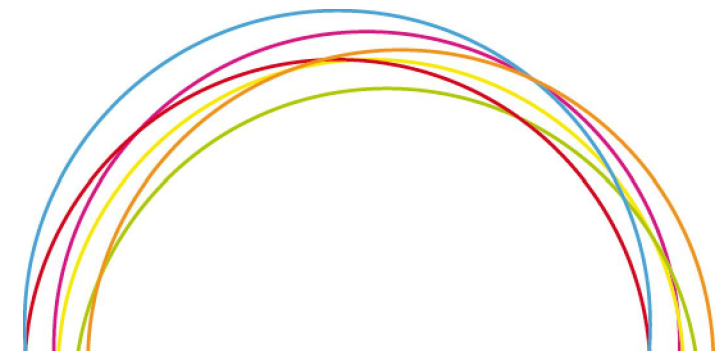


- 1) Case study on Heat waves: Health preparedness and response. *Example: Mayor of London (2010): The Draft Climate Change Adaptation Strategy for London. Public Consultation Draft. Greater London Authority*

Hazard/Phenomenon	Dimension	Scale	Context/DRR cycle	Component	Indicator	Measurement
Heat Wave (Heat stress)	Social ecological resilience	Urban community E.g. City of London	Adaptive Governance	Social Learning	Ability of institutions, implementing agencies to reflect on policy outcomes	Observable mechanism to support the revision and updating of practices

- 2) *O'Neil, A. O'Neil (2012) 'Social Justice and the future of flood insurance', Joseph Rowntree Foundation, UK.*

Hazard/Phenomenon	Dimension	Scale	Context/DRR cycle	Component	Indicator	Measurement
Mainly flooding, but could be applied to other hazards	Social ecology financial resilience	Household to community level	Mainly recovery, but potentially multiple aspects of risk management actions	Risk transfer/Insurance	Access to affordable flood insurance cover irrespective of risk. Without which people may be unable to fund expensive recovery process, or may cause community blight	Realistic and affordable insurance for those in need. Percentage of households insured against flooding damage.



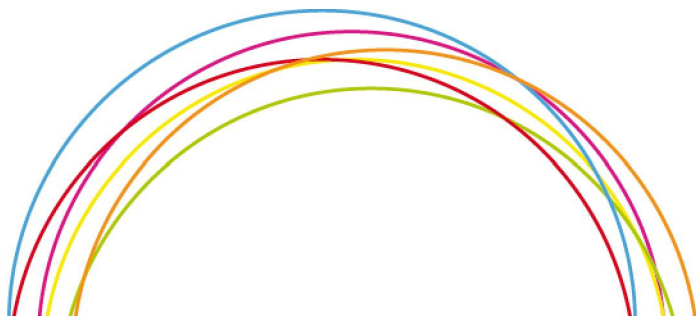


3) *Example: Mayor of London (2010): The Draft Climate Change Adaptation Strategy for London. Public Consultation Draft. Greater London Authority*

Hazard/Phenomenon	Dimension	Scale	Context/DRM cycle	Component	Indicator	Measurement
Heat Wave (Heat stress)	Social ecological resilience	Urban community E.g. City of London	Ex ante Preparedness And planning	Social Learning	Cooled Heat wave refugees (e.g. public buildings)	Number of openly accessible cooled buildings

4) Case study on Heat waves: Health preparedness and response. A theorised example

Hazard/Phenomenon	Dimension	Scale	Context/DRM cycle	Component	Indicator	Measurement
Heat Wave (heat stress)	Social ecological resilience/ Health resilience	Urban community e.g	Preparedness and response	Social capital/participation i.e. ability to join a governance process	Neighbours or community figures checking preparation and health status of isolated and elderly people before and during high heat periods	Community surveys or focus groups to identify details and level of community involvement and awareness





5) *Example taken from Twigg, J. (2009): Characteristics of a Disaster Resilient Community. A Guidance Note London: Aon Benfield UCL Hazard Research Centre*

Hazard/Phenomenon	Dimension	Scale	Context/DRM cycle	Component	Indicator	Measurement
ALL hazards (including climate change)	Knowledge and Education	Europe, National, Local and community	DRM cycle	Public awareness, knowledge and skills	Community awareness of risks, vulnerability and risk reduction activity sufficient for effective community action (in cooperation other stakeholders)	Not given. Indicators should stimulate discussion and be adapted to a specific context

This arrow demonstrates the relationship between indicators. It shows the potential for more general indicators, such as increasing hazard risk awareness, to provide a foundation for hazard specific DRR indicators for managing Heat waves (e.g. in terms of encouraging community DRR interventions).

(More examples required based on case study input to be developed)

Hazard/Phenomenon	Dimension	Scale	Context/DRM cycle	Component	Indicator	Measurement
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This report would kindly ask for the inputs of all case studies so examples can be presented in the indicator and measurements table (measurements do not necessarily need to be given) based on studied literature.





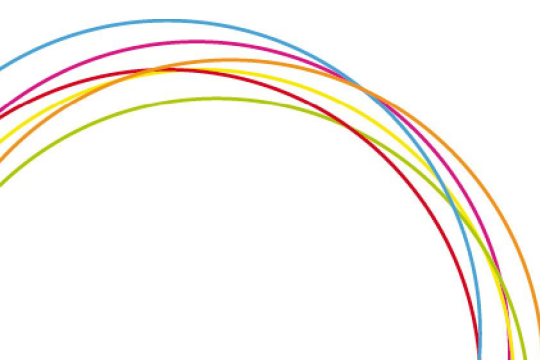
3.5 Multi Sectorial Partnerships and Resilience

One defining aspect of resilience to other core disaster concepts (e.g. risk and vulnerability) centres on its preoccupation with innovation and capacity to experiment. This section positions MSPs as innovative mechanisms (and indicators of resilience itself) able to improve functioning and effectiveness of systems designed to manage risk. The impacts and fallout of naturally triggered disaster events are often complex and far-reaching, generally most will have multi sector impact, and consequently management derived from a single sector or single actor may be inadequate, since technical expertise is always generally required. Thus, a direct response needs partnership and collaboration between three key sectors of society:

- Private sector institutions (including enterprise and public services,) particularly in neoliberal economies, are able to control public services; this can include social services that have contact with elderly people who are vulnerable people to climate extremes. Also, private enterprise may operate key critical infrastructure.
- Public sector generally forms the backbone of hazard risk management, this can include central government, local government, government agencies (including non-departmental public bodies), and various infrastructure.
- Civil society incorporates the notion of community, grass roots groups, Non-Governmental Organisations.

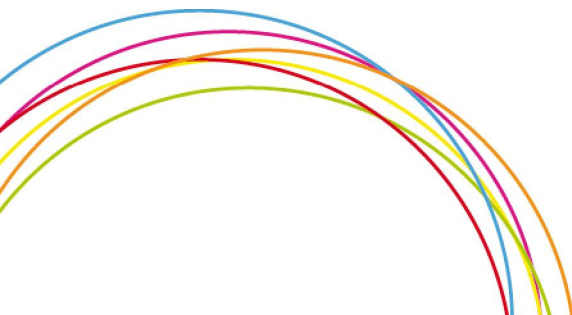
One of most novel aspect to MPS's is the involvement of communities, the embodiment of civil society. The incorporation of civil society actors into a partnership agreement has proven to be effective in guiding sustainable hazard planning (Djalante et al, 2011). An example can be drawn from the landslide prone Portella valley, positioned on the well-known San Andreas Fault in San Francisco. Research suggests that improvements in hazard risk management are primarily due to significant community involvement, a process achieved through bridging a strong relationship with local residents through developing participations (including leadership) in risk assessment processes. This culminated in the formation of a geological hazard committee, which in effect represented a civil-led institutional body, in close collaboration with public management authorities (Peace, 2003).

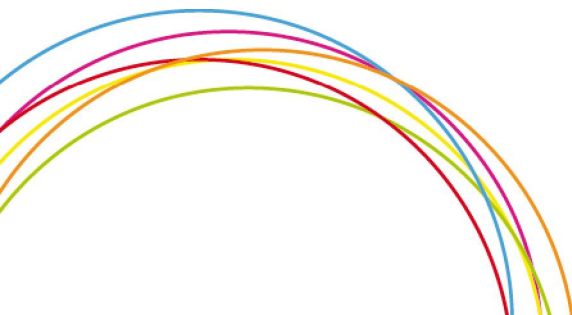
A partnership, in essence, builds collaboration between different actors who bring with them, ideas, experience, and knowledge able to eclipse the performance of single organisation on its own. To put the idea of partnerships in a Disaster Risk Reduction context, work has been produced which emphasises stakeholder partnerships designed to increase resilience and reduce risk. Twigg (2009) has provided some *characteristics* on a stakeholder partnerships aimed at building a resilient community. Guidance, such as this, on partnerships characteristics can be useful in developing some constituents of an effective agreement between different sectors and stakeholders. Embedded within a thematic area of governance, the following attributes of effective partnerships were described: **Integration of activities; shared vision; consensus; negotiation, participation, collective**





action, representation, inclusion, accountability, volunteerism and **trust**. These overlap with aforementioned sub components of resilience within governance, showing that agreement is slowly building of what governance processes are needed to facilitate better management activities. The above characteristics may provide an interesting basis for MSP development, used to identify, examine, and stimulate interest and opportunities.







4 Conclusion

This report, which forms working paper 2.2, has presented some core concepts, perspectives, components and indicators of resilience. Resilience is a key concept for hazard cases studies to integrate into their research plans. It represents an all-encompassing and capacity driven approach to frame the needs of society, in order for it to sustainably develop amidst the risk of catastrophic disaster events and the already observed influences of climate change. Although there is certain dissidence between approaches, the resilience concept offers the potential to facilitate the blending of knowledge streams (from disciplines and experiences) between different stakeholders, as they attempt to anticipate and manage processes of change. Because of this, its power may also extend to fostering communication between sectors and organisations that are active and responsible for managing hazard risk (currently) as well as for those who have up until now not be especially involved in risk management processes.

There is a great need to develop and begin empirically testing the resilience indicators, and build up associated indicators of successful (as well as (un)successful). This report aims to 1) catalyse and guide research into a risk management approach to building natural disaster resilience at different scales, and 2) further theoretical understanding on the characteristics of MSP's, as means to encourage more research on them. The report offers a dynamic conceptualisation regarding Disaster Risk Management which is positioned as a key instrument in negotiating a resilient pathway. It advocates for an alternative risk management approach to increase resilience. As part of this, consideration is given to the role of Multi Sector Partnerships (MSP's) as both an innovation and potential indicator of resilience. It offers guidance for how MSP's can be framed as innovative learning mechanism supported by various capital resources, able to enhance a range of risk management actions of (see fig1 in Del, 2.4). The report represents a tentative first step in moving towards a comprehensive theoretical framework for the ENHANCE project. In this vein, development will be critically informed via the findings of ten case studies.

Greater empirical research is needed to compare, analyse and link methods of assessing resilience (starting with the main components) and risk management effectiveness. As a risk management approach is likely to be a significant proxy on overall disaster resilience. Not only this, but such risk strategies are appear pragmatic as they focus on tapping into and building on current resources, expertise and experiences from realm of disaster risk management.

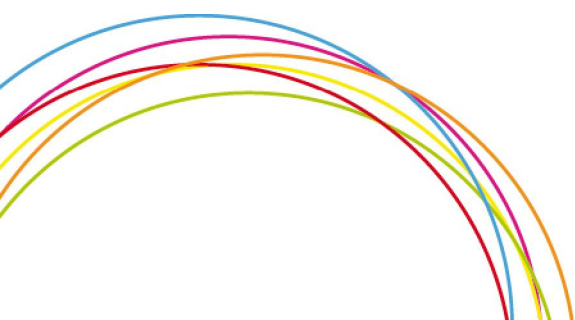




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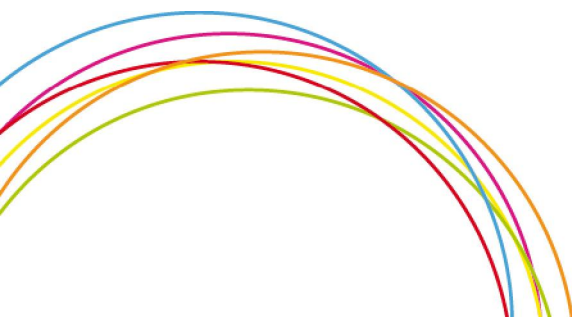
We would like to thank the concurrent emBRACE (EU FP7) project which is dedicated to exploring the concept of resilience. We are grateful to Dr Hugh Deeming for his helpful advice and permitting access to a variety of emBRACE resources some of which, it is important to note, are still under review and subject to change. From Centre for Research on Epidemiology of Disasters, the intellectual support of Jose Rodriguez-Llanes and Peter Hedulass was valuable.





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