Deliverable 5.1 of the FP7 SMARTeST project: Principles of Integration

SMARTeST

SMARTEST – D. 5.1

Prepared for: Adele Lydon
Project officer
European Commission

June 2011

Client report number
SMARTeST – D. 5.1

Prepared by

Name	Dr. Iain White, Dr. Paul O' Hare, Nigel Lawson, Adam Barker and Dr. Joanne Tippett.
Position	University of Manchester
Signature	

Approved on behalf of SMARTeST

Name	Jean-Luc Salagnac	Stephen Garvin
Position	Scientific Director	Coordinator
Date		
Signature		

SMARTeST FP7 Project
BRE
Kelvin Road
East Kilbride
Glasgow, G75 0RZ
T + 44 (0) 1355 576200
F + 44 (0) 1355 576210
E eastkilbride@bre.co.k
www.floodresilience.eu

BRE Client report number SMARTeST – D. 5.1

This report is made on behalf of the SMARTeST Project. By receiving the report and acting on it, the client - or any third party relying on it - accepts that no individual is personally liable in contract, tort or breach of statutory duty (including negligence).

Contents

PART 1 - DELIVERABLE 5.1:

PRINCIPLES OF INTEGRATION

1. INTRODUCTION

In Europe flooding has been traditionally managed by a large scale, technocentric paradigm, whereby entire towns and communities are usually protected by hard flood defences designed to hold back water. Changing climates, burgeoning populations and escalating urbanization has undermined the effectiveness of this methodology, whilst recently there has been an upward trend in flood events across Europe. Of particular concern has been the shift toward intra-urban flood events; inundation caused by an excess of surface water, occurring outside the parameters of many structural measures designed to address threats from floodplains and coasts.

As the need for more effective and adaptive managerial intervention has become apparent, attention has turned to integrating resilience into the built environment. Implementing Flood Resilience (FRe) approaches could help the management of flood water by providing building and community scale management and speeding the recovery of people and places. This could be particularly beneficial in areas where there is uncertainty regarding the efficacy of current methods or where defences may be unavailable. The approach may also have particular value when used in conjunction with other features on a system basis, or by using smart features that deploy automatically. Yet, despite the recognition of the value of FRe in creating greater resilience across Europe, its *widespread* and *comprehensive* integration into flood risk management remains elusive. There is still a need to establish a clear road to market and to address the barriers associated with this approach.

1.1 Background to SMARTeST

The SMARTeST Project aims to investigate, develop and disseminate knowledge to help enable flood resilience. It will achieve this by identifying obstacles and challenges in the design and integration of FRe and by isolating and highlighting opportunities for their promotion. Specifically, the Project is designed to improve the road to market of FRe technologies, particularly innovative or so-called ‘smart’ FRe features. These features rely less upon human intervention for their deployment and often require less maintenance and monitoring, potentially improving their overall efficiency and effectiveness.

The project will achieve these aims by:

- supporting the design of holistic flood defence systems;
- reducing the obstacles and reluctance to implement FRe;
- developing a series of decision-support tools that support integration; and,
- supporting the implementation of the emerging Europe-wide flood risk management policy of ‘Living with Floods’.

SMARTeST is organised into six main work packages:

- Work Package 1 – Project management.
- Work Package 2 – FRe Technology
- Work Package 3 – FRe System design
- Work Package 4 – FRe implementation tools
- Work Package 5 – Integration and practice
- Work Package 6 – Dissemination

1.2 Work Package 5: Integration and practice

Work Package 5 is primarily concerned with 'Integration'. It draws together the theory and practical research in Work Packages 2, 3 and 4, with a view to demonstrating how FRe technology, systems and implementation can be delivered in practice.

The Work Package has three primary deliverables, as follows:

- D5.1: Report on the principles of integration (Month 18).
- D5.2: Workshops and participatory planning sessions to use and assess the implementation tools in case study areas (Month 30).
- D5.3: An assessment report with best practice examples of strategic and local planning to accomplish integrative flood risk management, by making use of the FRe technology, systems and implementation tools (Month 36).

1.3 What is Integration?

At its simplest, integration means pulling together and making the most of the parts. In terms of FRe, integration can be thought of in terms of both *achieving beneficial synergies* internally – raising awareness of the need to achieve multiple benefits from research partners; and *enabling implementation* externally – how best to get FRe into practice. Not only are positive outcomes more likely to happen when integration is actively considered, but there is less likely to be duplication of effort and a waste of resources.

Therefore, combined, these two integration challenges provide a rationale for the project:

1. enabling the working together of differing scientific expertise; and
2. enabling the implementation of FRe.

Integration can most usefully be seen as a *process*, not an end state to be achieved. As FRe involves multiple interactions across multiple scales, system management is challenged by complexity and dynamism. Thus moving towards integration requires a constant process of engagement and communication; both internally within the project and externally to FRe stakeholders.

1.3.1 Enabling internal synergies

In a project like SMARTeST, with multiple teams from different countries, it is important to take an active approach to integration between partners, ensuring that information is shared and existing assets and resources are used effectively and efficiently. Working to achieve beneficial synergies for a wider range of people and stakeholders in turn enables implementation. Asking how actions can provide multiple benefits for other actors and communicating the outputs of research at early stages makes it more likely that others will consider the outputs within their work. The process of working towards integration therefore highlights the importance of cooperation to help the project achieve its overarching goals.

As integration is a process, consideration needs to be given to an accepted methodology. So the deployment of an agreed methodology will support synergies between national contexts and the advancement of understanding. Project meetings organised by Work Package 1 are also vital in this regard. In conjunction with other partners, Work Package 5 will therefore use the case studies to design a methodology that itself facilitates integration, an example being the National Reviews conducted by all partner countries utilising the same questions.

1.3.2 Enabling implementation within the external environment

Contemporary FRe integration is clearly considerably more complex than previous flood defence approaches, which were determined at a strategic state level, often by an authoritative stakeholder. FRe however, particularly when considered on a system basis, involves multiples scales down to the individual building; it also includes an expanded array of stakeholders from private sector companies to professionals with influence over the built environment. The process of integration requires us to ask: what is occurring at differing scales – both regarding enablers and barriers? And how can the activities of stakeholders across these scales be aligned?

Two axes of integration have been identified that capture these integration requirements – *vertical integration*, concerning the scales of influence, and *horizontal integration*, regarding the agencies of influence. These will be explained in more depth later.

1.4 Deliverable 5.1

This initial report derives from an acknowledgement that the context, innovation, diffusion (uptake) and maintenance of FRe (that is, 'the road to market') faces many challenges - even reluctance - from many sources and for a variety of reasons. These must be identified and assessed. The data collection strategy is outlined below.

Table 1.1: Data Collection Methods in Deliverable 5.1

BACKGROUND ANALYSIS	**Review of scientific literature and of 'FRe' concepts and practice**
INTERVIEWS	**Exploratory interviews with key FRe stakeholders**
SITE VISITS	**Communities at risk and product manufacturers**
WORKSHOPS	**Members of the National Support Group and project partners**
NATIONAL REVIEWS	**Detailed analysis of issues connected with flood risk management and FRe in SMARTeST Project partners countries**

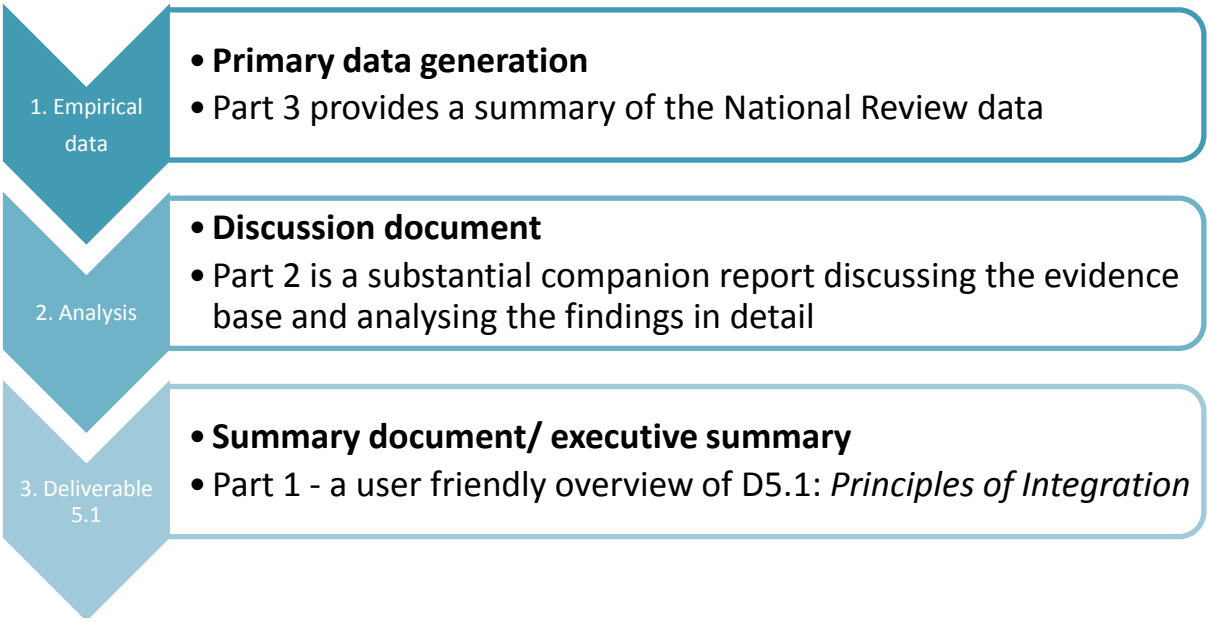
The initial background analysis established that the use of FRe would differ spatially across the EU, particularly when considering regulatory, financial and cultural issues. This was a view confirmed by the interviews, site visits and workshops, as, for example, the FRe sector emphasised the challenges of operating outside their national boundaries. 'National Review' templates were designed for each project partner to collect comparable data concerning both flood risk management and FRe. These comprehensive documents provided much of the raw data and have formed a cornerstone of Deliverable 5.1. Figure 1.1 details how these stages are compiled.

The returns from every National Review are synthesised in Part 3; and in depth analysis of the data is provided in Part 2. This document, Part 1, provides a user-friendly overview of the main findings.

Innovative or 'smart' technologies, tools and systems of flood resilience exist, and in several cases have been available for some time. However, their effectiveness, acceptability and usage are not widely acknowledged. For example, they are not recognised as an integral component of flood risk management by decision-makers, administrators or communities at risk. Moreover, even in cases where an FRe product is potentially efficacious, its practical adoption may encounter a wide range of hindrances, such as who should pay for its installation (the home owner, the insurance company, the Local Authority, etc) or in agreeing the most appropriate testing and accreditation regimes. This report will survey these challenges across selected European countries and

will highlight *Key Issues* in a text box within each relevant area. ***It ultimately aspires to identify a series of key issues affecting the implementation of FRe; aspects which will be subsequently further investigated within deliverables 5.2 and 5.3.***

Figure 1.1 Structure of Deliverable 5.1



2. THE RESILIENCE AGENDA

The concept of resilience refers to the ability of a system to recover from perturbation and shocks. It was a core concept of Holling's (1978) adaptive approach to environmental management, which recognised that change and uncertainty is inherent in complex system. System management should, therefore, aim to embed resilience in the face of change rather than rather more static forms of stability. The concept has gained increasing traction in the study of socio-ecological systems (Gunderson and Holling, 2002; Folke *et al*. 2005; Adger *et al*. 2005; Rockstrom *et al*. 2009; Costanza *et al*. 2000; Ostrom 2009). Although resilience has the potential to enable society to better cope with uncertainty and complexity, there is recognition that achieving resilience in practice requires greater understanding of the barriers and opportunities affecting the transfer from theory to practice (White 2010).

A succession of flood events across Europe, combined with a rising awareness of the difficulties in effectively managing water, has led to an acknowledgement within many nations that the *prevention* of flooding is an unrealistic aspiration. The long-established 'flood defence' paradigm was no longer seen to be completely effective given the uncertainty of flood risk and the growing appreciation of the contrasts between differing types of floods. Consequently, there has been a distinctive shift towards flood risk management – an alternative, more comprehensive approach that aims to not only reduce and mitigate risk, but to consider wider human and socio-economic factors. Flood resilience is viewed as a key of this approach. It includes measures to keep water out of a building and to reduce the time for any repair if inundation does occur, limiting the effect of flood upon both places and people. In short, FRe is critical for three interconnected reasons: its ability to *address uncertainty*; its potential to *minimize impacts*; and in facilitating *capacity to respond* to flood events (White 2010).

One aspect of flood risk management is to make the population of cities more aware of, and resilient to, flood risks. This alteration is reflected in the pragmatic tenor of recent policies with impulsions to 'learn to live with rivers', 'live with the risk' and 'make space for water' (Institution of Civil Engineers 2001; Environment Agency 2005; Defra 2005). The European Floods Directive reinforces this wider view advocating a focus on *prevention, protection,* and *preparedness,* in addition to more effective emergency responses and recovery plans (EU 2007). These measures, which can complement existing engineered approaches, also underline how flood risk management should encompass consideration of measures that can be taken both before and after and flood, such as the four A's: *Awareness*; *Avoidance; Alleviation;* and *Assistance* (Ashley *et al.* 2010).

This transformation has a series of critical implications. For instance, 'simple' relationships of responsibility between the State and its key managerial organizations

have unravelled. As the challenges of flooding are exacerbated by forces beyond the control of any one agency there is a commensurate onus on responsibilities to be shared. The 'living with risk' agenda, within which prevention is pursued alongside an ability to cope with any possible impacts, could be achieved across multiple scales and professions; including the public sector, the private sector, communities, households or even individuals. Moreover flood management can be retrofitted on a building or at community scale behind defences, influenced by non-structural measures within the wider system. The implication of devolving power and responsibility from the state towards communities and individuals is still emerging, but what is clear is that the new array of agencies and the expansion of spatial scales have created an increasingly fragmented environment against which FRe must be integrated.

For FRe to be implementable across Europe attention must be turned to integrative policies and practices to help reduce barriers to use and to smooth the road to market. It is here that the SMARTeST project is placed: aiming to integrate fragmented approaches and to help translate the emerging EU policy narrative into practice.

- **Flood risk is inherently dynamic and uncertain, making it difficult to prevent using engineered flood defences.**
- **The shift in risk from floodplains and coasts to localised intra-urban flooding presents a further critical driver for FRe.**
- **Resilience includes both human and technical aspects.**
- **Flood risk management and the 'living with water agenda' require changes in governance to include multiple scales and wider stakeholders.**
- **FRe needs careful integration particularly within fragmented contexts.**

3. FROM FRAGMENTATION TO INTEGRATION

FRe enablement requires new partnerships and understandings to be developed – both *internally* within the project regarding integrating disciplines and knowledge, and *externally* with regard to implementing FRe in practice.

Table 3.1: Internal and External Integration

INTERNAL INTEGRATION	**Issues connected with helping the Project to function. Whilst individual technology or decision making tools can help the FRe implementation, these measures can be mutually reinforcing whereby, for example, one element of the system could be integrated with others to help embed smart FRe within areas subjected to differing risks. In this way a 'smart' approach would be more than the sum of its parts, but demanding considerable communication from project partners.**
EXTERNAL INTEGRATION	**This will first look at integration vertically over the varying scales that FRe can be considered. Integration is also analysed from a horizontal perspective, encompassing the array of agencies of influence. By considering the views of these wider stakeholders the project can further assist the integration of FRe into practice.**

In essence flood risk management demands new ways of working and may be understood as a move from a *fragmented* managerial approach to a more *integrated* one, where ideally multiple stakeholders play mutually reinforcing roles. This trend has already been championed in the field of water management as a whole, such as within the Water Framework Directive and the Floods Directive. Increasing the quality and coverage of data is seen as central to operationalising these policies, but success does not, however, hinge simply on the provision of more accurate and comprehensive data. Nations are not just suffering from a lack of data in attempting to 'plan for resilience' in the water environment; they may also experience a relative *data-rich but information-poor* syndrome (de Pauw 1996). This phenomenon may be a recent development, where the volume of data is greatly increasing but it is of limited value unless it can be used in decision making tools and processes. This means that firstly, the scientific community must communicate more effectively; and secondly that the sustainable management of water requires integrated planning, recognising the interconnections between systems operating at different spatial scales, and the complex interactions of multiple stakeholders.

The SMARTeST project recognises this need for dual integration. Table 3.1 outlines how Work Package 5 is designed to pursue integration in these two distinct ways.

3.1 Internal integration: linking technology, systems and tools

Deficiencies with fragmented decision making, large-scale structural approaches and data and modelling capabilities have highlighted that the complexity and uncertainty of flooding calls for greater resilience, which in turn places demands on the governance of both flooding generally and FRe more specifically. One of the challenges of the SMARTeST project is to recognise the problems of current fragmented knowledge and to be proactive to communicate between work packages and research teams. With regard to this project internal integration can be thought of as consisting of four interlinked sectors, each of which are explored in Work Packages 2, 3, 4 and 5 of SMARTeST:

- integration of FRe *technical* responses;
- integration of FRe into the wider *system*;
- integration of FRe into decision making *tools;* and,
- integration of FRe into *implementation* processes.

Additionally, by considering this approach within the partner countries, the project can help integrate this knowledge into differing national contexts.

Internal integration can therefore be seen as a process from an initial fragmented outlook, towards one where gradually partners explore how independent scientific and disciplinary approaches can achieve beneficial synergies. This goal will be pursued throughout the project. Although Work Package 5 will outline key principles in the final section of this report, it is the responsibility of all partners to consider them.

Table 3.2: Internal Integration

WP 2: FRE TECHNICAL RESPONSES	**Recently, technical approaches to flood risk management have been expanded to include non-structural methods and smaller-scale FRe technology that could operate either behind, or instead of, traditional flood defences. This Work Package explores technical aspects of FRe in more detail and the effectiveness of 'smart' or innovative FRe will be examined.**
WP 3: FRE AND THE WIDER SYSTEM	**A drive to consider the influence of the wider urban *system* within flood risk management has been recognised within both academia (White 2010; Zevenbergen *et al*. 2010) and encouraged by shifts in policy, such as the Water Framework Directive and the Floods Directive (European Union 2000; 2007). This outlook would include aspects such as the natural and artificial characteristics of hydrology determined by the use of land, built environment and ecosystems within the urban area and the wider catchment. It would also consider those 'human' elements of a system that can reinforce technical aspects.**
WP 4: FRE AND DECISION MAKING TOOLS	**Advances such as better tools and spatial visualisations can help operationalise smart FRe resilience. However, decision support must reflect how tools can consider technology in order to improve the management of FRe from a system perspective. Work Package 4 of the project will develop decision making tools specific to FRe and explore how these can be best applied within differing urban areas.**
WP 5: FRE AND IMPLEMENTATION PROCESSES	**Involving individuals and other stakeholders in managing and adapting to flood risk both helps to develop effective solutions and facilitates their practical implementation. FRe must engage with both flood risk professionals and communities exposed to risk and expected to become resilient. Their views and efforts may be integrated with consideration of smart technology, urban systems or decision making tools in order to facilitate use, assign ownership and promote wider responsibility.**

3.2 External Integration: vertical and horizontal approaches

In the EU the defence against flooding has historically been pursued by arrangements between the state and the public, brokered by strategic level organisations that attempt to manage flood risk through the construction of large-scale engineering-led solutions. A defining feature of this approach has been the limited number of actors and agencies involved in the decision making process.

The wider array of scales and agencies that now play a role in flood risk management requires improved integration of practices and processes; this is particularly the case for FRe which is an emerging approach. The National Reviews revealed that problems affecting FRe from across the EU could be categorised as occurring from both fragmented spatial (scales of influence) and sectoral (agencies of influence) aspects. To provide conceptual clarity, therefore, the external integration of FRe was considered in both *vertical* and *horizontal* terms. Table 3.3 provides a summary of this approach.

Table 3.3: Summary of Vertical and Horizontal Integration Aspects

VERTICAL INTEGRATION	**Vertical integration may be defined as the entirety of governance from the EU, to the Nation State, to Local Municipalities to the community. Ideally, the achievement of integration in this context would entail the assimilation of efforts both within and across scales, merging 'top-down' and 'bottom-up' approaches, forming a concerted promotion of FRe. In addition to co-ordination across spatial scales, integration must also consider the co-ordination of multiple, and sometimes contradictory, policy frameworks.**
HORIZONTAL INTEGRATION	**A move toward horizontal integration complements the vertical approach. It includes a consideration of the views of all the wider stakeholders who can play a role in FRe. Previously, the main agencies with power over facilitating the management of flooding were formal, usually statutory, organisations with almost sole command over financial resources and decision-making. But to achieve better integration necessitates the inclusion of many further stakeholders, including built environment professionals, land managers, the construction sector, the development and finance sectors, the insurance sector, the public and those companies who design and sell FRe technology. Through their co-ordination and co-operation, the 'road to market' for smart FRe will be less contradictory, complex and problematic.**

Figure 3.1 demonstrates the shift in approach from flood defence to flood risk management across *vertical* and *horizontal* analytical themes. These key stakeholders and spatial scales will be explored in more depth in the following two chapters and are key framing devices to be used throughout Work Package 5.

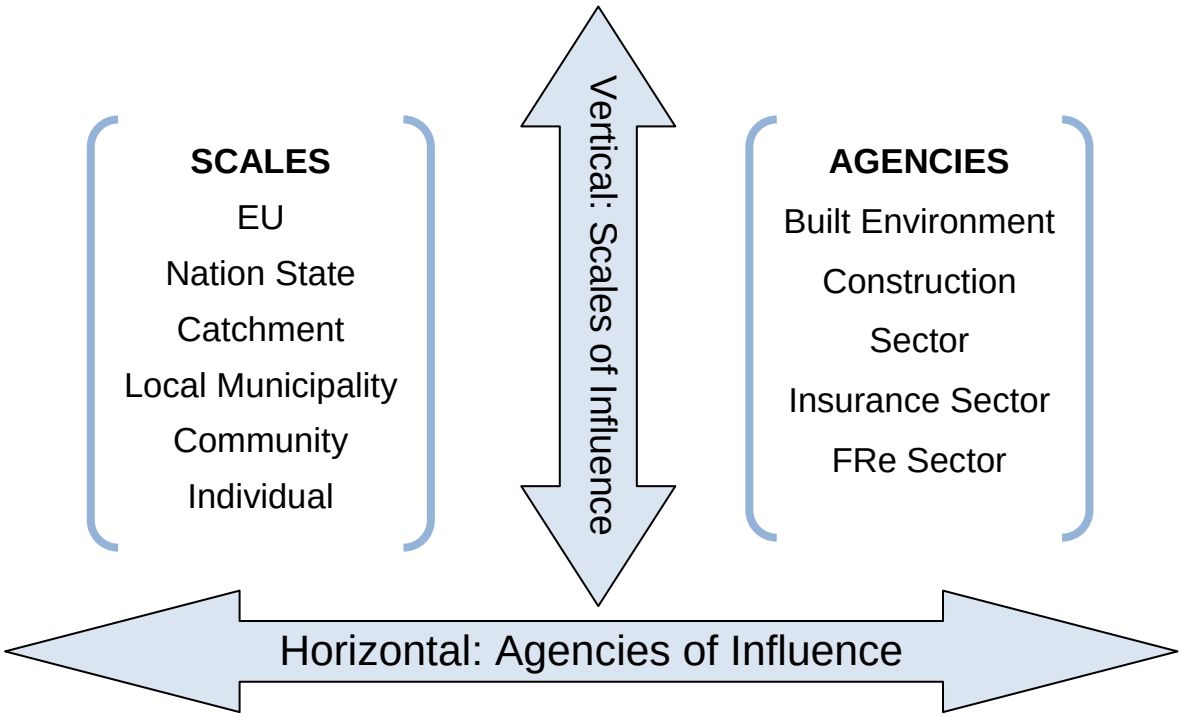


Figure 3.1: A representation of horizontal and vertical integration in FRe, detailing the key scales and agencies with influence

- **Flood risk management requires new partnerships and a more sophisticated understanding of FRe to be developed.**
- **The widening of stakeholders with a role to play in flood management demands effective communication within the project to achieve beneficial synergies.**
- **FRe needs to be effectively integrated externally by stakeholders beyond the project. This is framed in terms of both vertical (the scales of influence) and horizontal integration (the actors and agencies of influence).**

4. VERTICAL INTEGRATION

This section examines matters arising for the 'vertical' integration of FRe examining opportunities and constraints produced *within* and *across* spatial and governance scales – from Europe, to the Nation State, to Local Municipalities and the community.

4.1 Integration at the European Scale

The most significant EU policy development likely to impact upon FRe developments within the Member States is Directive 2007/60/EC (Floods Directive). The Directive requires Member States to assess areas likely to be at risk of flooding, to map the extent of possible floods and to identify assets and humans at risk.

One of the central assumptions contained within EU environmental policy is that diversity is compatible with Member State equity and harmonisation, yet Member States with less experience of integrated flood management (most notably Greece and Cyprus) will inevitably find the processes of transposition more costly and resource intensive than States with established flood management systems.

• **The ease of policy implementation differs spatially. The subsidiarity principle enables discretion between states creating both challenges and opportunities for FRe uptake**
• **Having some national freedom to interpret the Directive may inhibit the potential of the private sector and FRe technologies to operate across countries**
• **Some states have existing frameworks whilst others may need to create theirs anew**
• **Some members are better prepared to facilitate FRe uptake. There is also the potential for best practice to be highlighted**
• **Implementation of the Floods Directive may be affected by (public and private) spending cutbacks. This is both a constraint but also an opportunity for FRe integration**

4.2. Integration at the National Scale

The significant problems when integrating *between* states at the EU level is compounded by a lack of clarity about process and procedures even *within* many countries. Further,

the governance dynamic between the nation-state and lower tiers of governance are in constant flux. Relations are fluid, with power and responsibility unsettled and varying over time, across issues, and as they rise and fall in reflection of their political imperative. It is challenging, therefore, to definitively assess the consequence of administrative reform on the development and uptake of FRe, with critical impacts upon integration.

• **Responsibilities for flooding are being transferred from the state to other stakeholders.**
• **The management of flood risk is therefore more fragmented with limited institutional co-ordination undermining efforts to take action. There is also, though, increased opportunities for dialogue.**
• **Delineations of responsibility for leading policy initiatives, such as FRe, may lack clarity. Roles may be split between stakeholders and conflicting aims often arise.**
• **The transference of flood preparedness into standards and codes is in its infancy and in some places does not exist at all.**

4.3. Integration below the Nation State

Authorities at the local, municipal or city scale have a potentially significant ability to influence FRe. They interpret national guidelines and regulations and make decisions concerning the use of land. These statutory actors, along with the private sector, also have a considerable influence upon the public (communities, individuals and also civil society organisations such as non-governmental organisations and pressure groups).

• **Political will has a considerable impact upon FRe implementation.**
• **There is increased onus on the public (communities and individuals) to manage their own protection against flooding, but this is not acknowledged or accepted by all.**
• **State provision of compensation for flooding strengthens the perception that protection too is a state responsibility detrimentally affecting the FRe market**
• **Some members of the public are unconvinced about the effectiveness of FRe, preferring large defences. They are also resistant to the 'Living with Water' agenda**

- **There are cultural and psychological barriers to both the concept of self protection and FRe within EU countries.**

4.4 NGOs and civil society

Civil society organisations, such as national or local non-governmental organisations, can emerge as critically important actors in facilitating and supporting the integration of FRe. They might, for instance, act as advocacy organisations, promoting the issue of flood protection or representing communities at risk.

- **Civil society organisations can be important in facilitating FRe and acting in an advocacy role. They can also pool resources and focus power.**
- **Using FRe on a system or community basis may need partnership working and consensus building with stakeholders, but this presents many deep challenges.**
- **FRe may be seen to detract from property values providing a further disincentive for users.**
- **Even where willingness to use FRe exists, some remain unconvinced that their purchase is a worthwhile financial investment, or may simply be unable to afford FRe installation and maintenance.**
- **In many circumstances the public are disengaged from flood risk management and FRe.**

5. HORIZONTAL INTEGRATION

Attention is now turned to *Horizontal* integration, which refers to the widening of engagement to include all those stakeholders with a potential role to play in enabling the use of FRe. Although this creates many opportunities for FRe integration, engagement with a wide array of stakeholders also brings challenges and problems. The section will briefly describe issues connected with risk and modelling, before focusing on sectoral themes.

5.1 Perceptions of Risk and Resilience

As it can greatly influence the 'road to market' of FRe, it is vital to consider issues connected with the perception of risk and resilience by differing stakeholders and the way that these concepts may be understood. For example, the construction and interpretation of data by scientists is subjective and different professions and agencies may interpret information in conflicting ways. Moreover, citizens to whom this risk is subsequently communicated may be risk averse, or alternatively may be willing to accept different levels of hazard, making the perception of risk a matter of considerable influence.

• **Risk is subjective and stakeholders may perceive risk and any responses differently. There is also no consensus regarding who should pay for FRe.**
• **Assigning a value to a risk and any remedial action is useful for decision making, but may also present communication challenges.**
• **Risk communication may not reflect the real chance of detriment, affecting the choices that may be made.**
• **The public may not understand how stakeholders manage risk on their behalf.**
• **The public trust some stakeholders more than others to provide risk management.**
• **FRe, and resilience more generally, is a valuable response to uncertain risks.**

5.2 Modelling and Mapping

The role of decision support tools, such as mapping and modelling, is critical to effective flood risk assessment. Whilst this increase in available information does improve decision

making, there is considerable scope for progress. There is also great disparity across Europe, presenting a further challenge for FRe integration and in smoothing the 'road to market'.

• **All governments take responsibility for either national and/or regional flood risk assessments or mapping.**
• **The quality and the resolution of flood assessments and maps vary considerably. Several assessments include, or seek to include, socio-economic damage data.**
• **The scales of models may currently be inadequate to consider and assess FRe.**
• **The Floods Directive requires the creation of flood risk maps and management plans, including measures relating to prevention/ protection that support FRe.**
• **The Directive excludes the mapping of flooding from sewerage systems hampering the ability of FRe to manage this particular risk.**
• **Some mapping data is held by the private sector or is not in the public domain, presenting further challenges.**
• **High quality, clear and user-friendly maps would help inform the public regarding flood risk.**

5.3 Built Environment Professionals

Flood Risk Management should be managed by a range of actors and agencies. A key position is occupied by planners, architects and other 'built environment' professionals. Professionals must understand how best to interpret risk models, engage with uncertainty, communicate effectively and integrate FRe into sound decision-making processes.

• **FRe needs to adapt to established procedures to managing land and buildings.**
• **Many planning systems zone development away from areas at highest risk.**
• **FRe guidance for built environment professionals is starting to appear, but this is not widely available as yet and its absence inhibits capacity building.**

• **Guidance may also be simple and not address key barriers to market.**
• **There is little ability by these stakeholders to retrofit FRe.**
• **FRe can be promoted by built environment professionals, particularly in low/medium risk areas, or within retrofitting projects.**
• **Built Environment Professionals could benefit from collaboration or play an arbitrary role to establish an accepted view on FRe in an area.**
• **FRe may appear at the planning stage of development, but the barriers mean it is often not implemented.**

5.4 The Construction Sector

The construction industry sector, including civil engineering, manufacturers, contractors and SMEs, etc, can be a key player in making FRe standard within developments. The number of FRe products on the market continues to grow and awareness is rising.

• **There is a perception that FRe is more expensive and/or complicated to install than non-FRe techniques.**
• **FRe is also perceived to be difficult to source and may meet homeowner resistance.**
• **There is a lack of skills and knowledge concerning FRe use in the sector.**
• **The sector is responsive to client or regulatory demands and can play an enabling or constraining role for FRe.**
• **There is little basic guidance available regarding cost, performance, etc.**

5.5 Insurance Sector

People who have been flooded generally look to the insurance industry for compensation and the sector can play either an enabling or resisting role for FRe. Although FRe can reduce the costs of damage and speed recovery time if a flood occurs, these benefits are

not necessarily acknowledged and the sector has a number of legitimate concerns regarding usage.

- **There are great variations in flood insurance across Europe: it might be compulsory or voluntary; state provided or market-based; and may or may not be part of generic household insurance policies.**
- **The way that insurance is provided affects public perceptions and the penetration of FRe. State provision of compensation for flooding may provide a disincentive for FRe integration.**
- **The road to market for FRe must contend with differing national insurance contexts. Often, countries which do not have state provided insurance are more attractive for businesses than those without.**
- **Insurers can insist upon FRe as part of any post-flood recovery, but this is sporadic and may be subject to 'no-betterment' (for instance the installation of FRe) clauses.**
- **FRe could lower bills for homeowners by increasing the number of companies willing to provide insurance or lowering premiums/excess. However, these potential financial benefits to users are unclear.**
- **Insurers could be more proactive in financing FRe but have concerns regarding performance, installation and maintenance. Many products are not clearly accredited or tested to the same standard throughout the EU.**

5.6 FRe Sector

Across Europe, a key stakeholder in FRe deployment and uptake is the FRe sector, who design, develop, invested in, install, maintain and market FRe.

- **Most FRe companies are small. There are few medium sized enterprises across Europe.**
- **Enterprises often lack economies of scale or specialised knowledge 'in-house'.**
- **It can be difficult to know how to bring a product from concept to marketplace. There**

is limited guidance for the sector.
• **Innovation is not financially supported by the state, despite the rhetorical encouragement of the private sector to play a role in flood risk management.**
• **In addition to market research costs, it was estimated to take €35,000 to get a product tested and another €35,000 to gain accreditation, which is a significant barrier innovation.**
• **There may be a fear of innovation from other flood risk management stakeholders due to the fear of liability.**
• **Homeowners may not think they are at risk, may not see FRe installation as their responsibility, may not want it on their property or may fail to maintain it correctly.**
• **Homeowners may not trust the FRe sector to provide impartial guidance**

6. THE ROAD TO MARKET

The translation of flood management innovations to practice depends upon their integration into flood risk management more generally, and the development process more specifically. Yet transition theory argues that technologies often have difficulties being accepted within the mainstream and that resistance is often situated at the level of institutions, technical systems, culture, and legislation, which requires reinforcement in social, cultural, economic and technical domains (De Graaf 2009).

This research is designed to address this issue by identifying and considering the manifold barriers and opportunities that affects FRe uptake and usage. The data collection revealed a broad array of factors with the ability to influence FRe within the stages of the road to market. Many aspects stemmed from wider thematic issues, such as economic, technical or regulatory concerns. Therefore, an analytical framework was needed to encompass both the (mostly) linear product development process and the cross-cutting issues with the ability to influence its operation and effectiveness. This section discusses the rationale for, and content of, the selected approach.

With regard to FRe, the initial conception of the idea is part of a market research and development phase, where the market is explored before the product is designed, tested and (in some cases) accredited. Once the technology is ready to be launched, more in depth consideration is given to the marketplace, commercialisation strategies and promotion. The final aspect involves marketing, sales, customer acceptance, performance and ongoing maintenance. The FRe Road to Market process can therefore be summarised as being a three stage model: *Market Research and Development*; *Promotion and Acceptance*; and, *Implementation and Maintenance*. Barriers and opportunities will be explored at each stage of the process.

Table 6.1: The Three Stage FRe Road to Market

MARKET RESEARCH AND DEVELOPMENT	**Market research, developing the idea, design, testing and accreditation**
PROMOTION AND ACCEPTANCE	**Business analysis, commercialization, marketing, pricing, product promotion, social learning and partnership development**
IMPLEMENTATION AND MAINTENANCE	**Uptake, performance and ongoing operation**

6.1 Identifying Framing Themes

As the previous chapters have outlined, influences on FRe are manifold, varied, and can be greatly dependent upon national, institutional, socio-economic, local and other contexts. For the sake of clarity and relevance across the EU, the analysis will be thematic – based along a series of key areas of analysis present within each case study area.

With regard to FRe, utilisation of this theoretical approach provides an effective mechanism to explore the complexities of issues. Table 6.2 details the selected cross-cutting FRe thematic influences.

Table 6.2: The FRe Thematic Influences (TRICEPS)

TECHNICAL	**Influences associated with design, development and technical issues**
REGULATORY AND LEGISLATIVE	**Influences imposed by legislatures and government agencies through the existence or absence of statutes, regulations and policies.**
INSTITUTIONAL	**Influences that stem from the internal workings or functions of entities that are stakeholders in FRe use.**
CULTURAL	**Influences associated with the cultural perspectives of FRe stakeholders.**
ECONOMIC	**Influences associated with the economics of FRe use.**
POLITICAL	**Influences according to policy and related agenda setting.**
SOCIAL	**Influences connected to civil society and social justice, including analysis of partnership working and social learning.**

The seven thematic groupings and their definitions, developed below are consistent with contemporary research and were selected for a number of reasons. Firstly, they relate directly to FRe, as each of the groupings had emerged from the literature review, interviews, National Reviews, NSG feedback and workshops. Secondly, whilst investigating this theoretical approach, it became apparent that there were trends within many of the categories identified by other researchers in similar fields (Vigar 1997; European Commission 2003; 2004; USEPA 2000).

Combining the RTM and thematic influences of FRe Work Package 5 can help construct an analytical framework to be applied in workshops within Deliverable 5.2. This will help further understand which barriers and opportunities dominate each stage of the process. Identifying and categorising issues in this manner is designed to focus attention on key aspects, both making the reasons for not solving problems easier to identify and tackle and highlighting areas of best practice (Petts 2004; Robinson 2004; Trudgill 1990; White

2005). Table 6.3 details this. It is an approach specifically designed to allocate attention and facilitate change (March and Olsen 1989) and may be considered a device to identify/ analyse FRe opportunities and difficulties.

Table 6.3: The FRe Analytical Framework to help identify key issues

	RESEARCH AND DEVELOPMENT	PROMOTION AND ACCEPTANCE	IMPLEMENTATION AND MAINTENANCE
TECHNICAL			
REGULATORY AND LEGISLATIVE			
INSTITUTIONAL			
CULTURAL			
ECONOMIC			
POLITICAL			
SOCIAL			

Table 6.3 will be populated with analysed data to develop a set of recommendations in Deliverable 5.3 with a view to encouraging effective innovation, to promote the wide-spread diffusion of FRe innovations, and to build the capacity skills and knowledge needed for effective uptake and management of systems in practice.

- **FRe road to market is a three stage model: market research and development; promotion and acceptance; and implementation and maintenance.**
- **There are a broad array of influences which can influence the road to market, these can be summarised as: technical; regulatory and legislative; institutional, cultural; economic; political; and social.**
- **Using an analytical framework can help capture the variety of issues of relevance for both these aspects.**
- **The framework will be populated in Deliverable 5.2 and will provide an agenda for the recommendations in Deliverable 5.3 – two Deliverables to come later in the Project**

7. PRINCIPLES OF INTEGRATION AND FUTURE STEPS

With regard to FRe, new technology will always emerge, systems will be subject to dynamic forces and decision making tools will be refined. The views of stakeholders will also differ spatially and culturally, whilst institutions and sectors will be influenced by political, social and economic factors. Yet, despite the complex array of integration issues outlined in this document, better partnership working within the project can create the potential to influence better FRe practice.

This may be understood as an iterative process from initially communicating research between partners within the project to finally implementing FRe in practice. In this way there is a *relationship* between internal and external integration, which may be understood as a gradual transition of knowledge from partners within the scientific community, to decision makers and from there to stakeholders and the marketplace. In this context integration can most usefully be seen as a *continuous process or a set of principles to be considered*, not necessarily an end-state to be achieved. In fact there may well be aspects of FRe which are difficult to integrate holistically.

This section will now summarise five key principles: *Communication; Demonstration; Comparison; Application;* and *Implementation*: the consideration of which will help SMARTeST facilitate a transition away from the current fragmented state of FRe. These encompass shifting knowledge internally within the scientific and policy making community towards a more integrated understanding which can be communicated to decision makers, wider stakeholders and end users. The principles are related to the extensive array of key issues raised throughout this report and may be understood as a set of guidelines to consider in order to maximise the potential impact of the research in practice.

7.1 Transfer from Internal to External Integration

Integration internally within the project is important to achieve multiple benefits from research partners. With greater partnership working there is an increased chance of gaining synergy and mutually reinforcing outcomes where, for example, the technology is considered within a wider technical and human system, and decision makers can utilise tools to improve decision making within this broad context.

The initial background analysis combined with data from workshops and meetings suggests that all research partners need to consider the key principles outlined in Table 7.1 to limit the potential for fragmented, silo based approaches. It details how these five

principles, based on the data collected within Task 5.1 can each in turn be used to help shape thinking to provide a common direction for all research partners.

Table 7.1 Principles of Integration: Transfer from Internal to External Integration

	PRINCIPLE	DESCRIPTION
Internal Integration	1. COMMUNICATION	Can our research be linked with findings from different work packages? If so, how?
	2. DEMONSTRATION	Can our research be easily explained and demonstrated to research partners, stakeholders and the public? Is it applicable to multiple audiences?
	3. COMPARISON	Does our research allow a comparison between using FRe and not using FRe: smart or non smart FRe approaches? Can it be quantified in economic or numerical terms?
	4. APPLICATION	Can our research be applied in different countries? Are there language or cultural barriers? Can it consider differing spatial scales, from the building to the community and city?
External Integration	5. IMPLEMENTATION	How can the research best be applied? How does it link with the road to market? Who pays? What are the barriers? Acknowledges any deficiencies in meeting the above principles, identifies what still needs to be resolved and suggests possible ways forward.

7.1.1 Principle 1: Communication

For integration to exist effective communication must take place between project partners. This includes different research teams, varying disciplinary backgrounds and seven national contexts. Meetings and discussions organised by Work Package 1 and other opportunities for engagement throughout the project are critical to maximise communication between the various partners to realise beneficial synergies. The data collection revealed that achieving this goal may not be straightforward, as for example, fragmented approaches are commonplace in flood risk management and interdisciplinary collaboration needs to be worked at in a continuous manner. All partners therefore need to be proactive in considering how their research and national context can be linked to others.

7.1.2 Principle 2: Demonstration

After the communication process has helped to reveal the links internally within the SMARTeST project, consideration needs to turn to demonstration. In particular, can our research be easily explained and demonstrated to each of the following groups: research partners, stakeholders and the public? Is it applicable to multiple audiences or must there be differing strategies for various groups? The data collection revealed that for FRe to influence stakeholders it needs to be able to be explained effectively and, if possible, demonstrated. Principle 2 starts the transition towards external integration as both the scientific community and wider stakeholders could benefit from demonstration of the capability of FRe.

7.1.3 Principle 3: Comparison

The methods selected to manage water have been largely determined by a cost/benefit ratio – whether by state level agencies, city planners, insurers, building managers or homeowners. Therefore, for smart FRe to influence decision making the effect needs to be quantified in either economic or numerical terms so it can be compared with alternative approaches. Questions include: is using FRe cost effective and, if so, by how much? How many homes or businesses can it protect? How much quicker can a property be used again after a flood? Essentially FRe needs to merge into the clear and easily quantifiable landscape that decision makers demand. Principle 3 is a key stage in addressing the vertical and horizontal barriers present in external integration.

7.1.4 Principle 4: Application

The data revealed that FRe needs to consider how it could be applied from a number of aspects. More specifically, can the research be applied in different countries and are there language or cultural barriers? Can the research consider differing spatial scales, from the building to the community and city? Can it link with other technologies and decision making tools in order to be applied on a systemic basis? This principle would help FRe be considered strategically and enable integration to be considered on an EU basis rather than within national contexts.

7.1.5 Principle 5: Implementation

Once the previous 4 principles have been addressed there is real potential for the implementation of FRe: the scientific community have communicated, the approach can be demonstrated and the effects quantified, and its application has been considered across differing spatial scales and national boundaries. Therefore, this stage considers more practical questions, in particular how can our research best be applied? How does it link with the road to market? Who pays? What are the barriers? It must also acknowledge

any deficiencies in meeting the above principles, identify what still needs to be resolved and suggest possible ways forward.

7.2 Future Steps for Integration

Douglas and Wildavsky (1983) suggest that although risk may be a function of social organization, the management of risks such as flooding is an *organizational* or systemic problem – therefore better integration of knowledge, technology, tools and systems can improve how FRe is understood by multiple stakeholders and assist its utilisation within management strategies.

Integration literally means the unification of a diverse set of elements. In terms of FRe, integration can be thought of initially in terms of *achieving beneficial synergies* internally – communicating between research partners and creating the potential for the sum to be greater than the parts. After this stage there is a requirement to consider how best to *enable implementation* externally – how to get FRe into practice and how to get multiple benefits; involving creating the potential of the approach to be integrated within existing decision making processes.

With regard to managing flooding, the modern notions of risk and resilience are seen to be particularly useful, as urban populations grow, the built environment expands and climate changes. In practice, our ability to effectively operationalise FRe will be significantly shaped by the way in which the scientific community *and* wider stakeholders, such as the built environment professions, interpret these concepts and use them to inform responses. Moreover, as FRe involves multiple interactions across multiple scales, the state of the whole system being managed is constantly changing. Thus moving towards integration requires a constant process of engagement and communication; both internally within the project and externally to FRe stakeholders. The process of integration can be thought of as one of asking questions – what already exists, what works, who else is doing things that could be of use – and of searching for ways to align interests and achieve compound benefits from the same action.

It should be noted that although FRe is a logical response to the uncertainty in managing flooding this does not mean the approach should not learn from stakeholder views and be receptive to feedback. For example, far from being a universal good, when translated into practice there may be significant spatial and social inequalities and even reluctance from end users. Once individuals and communities are encouraged to take responsibility for the level of risk they wish to be exposed to, protection from flooding is commodified within the public sector and there will inevitably be winners and losers. Moreover, communities and individuals have had little choice in assuming these responsibilities; moves to ‘live with water have emerged as a pragmatic centralized, top-down policy decision reflecting

the unpredictability and uncertainty of flooding and traditional flood risk management responses. The implications of these transformations in the governance of risk are only now being considered within academia and policy.

These principles can be used within the Project to promote a common vision of how to facilitate the transfer of the science of SMARTeST into first, a coherent whole, and into practice. Alongside these principles Work Package 5 will also conduct research on implementation using the analytical framework in Deliverables 5.2 and 5.3 to:

1. Identify and categorise barriers and opportunities relating to specific areas; and,
2. Highlight an agenda for recommendations

• **Integration is an iterative process from initially communicating research between partners within the project to finally implementing FRe in practice.**
• **Integration is a continuous process or a set of principles to be considered, not necessarily an end state to be achieved**
• **Integration needs to be pursued internally within the project - by enabling the working together of differing scientific expertise.**
• **Integration also needs to be external with wider stakeholders - by working towards enabling the implementation of FRe.**
• **There is a relationship between internal and external integration, which may be understood as a gradual transition of knowledge from partners within the scientific community, to decision makers and stakeholders within the marketplace.**
• **The 5 key principles of integration are: communication; demonstration; comparison; application; and implementation - the consideration of which will help SMARTeST facilitate a transition away from the current fragmented state of FRe.**

PART 2 – DATA ANALYSIS

1. INTRODUCTION AND METHODOLOGY

This section details the methodology employed to conduct the primary research used in drafting Deliverable 5.1. The Deliverable scopes the most pertinent opportunities and constraints facing flood resilience tools, technologies and systems. Given the composition of the research project, the report identifies issues from both across Europe and from within Member States, primarily conducted by analysing national insights from expertise throughout the SMARTeST team.

1.1 Background Analysis

A series of methodological tools were used to identify the key principles influencing integration. Over the course of months 1-6 the team at UNIMAN undertook a literature analysis to help scope the background to the project and identify key areas for focus. Similarly the team consulted with fellow project Partners and the UK National Support Group (NSG) to further understand institutional and sectoral perspectives. This included investigating the issues surrounding both internal and external integration. The team, in collaboration with Project partners, also developed a Project Glossary, which is available on the SMARTeST website (www.floodresilience.eu) and forms part of the contribution of WP5.

1.2 National Support Groups

The team at UNIMAN used the NSG to help refine the research approach, conducting workshops at each of the three meetings held up to April 2011. For example, UNIMAN gained valuable feedback on the FRe market in general, the broad scope of the questions that should be asked in the National Review, and assistance in drafting aspects of our own response from members of the UK NSG. Members were sent draft versions of the Review for comment. A series of questions of interest to the NSGs were similarly identified.

Given the composition of UK NSG members, the data collected was also useful on ascertaining issues relevant to the ‘road to market’. A questionnaire was forwarded to NSG members in March 2011, just prior to an April meeting of the NSG at the University of Manchester. At this event UNIMAN ran a 1.5 hour workshop that investigated matters arising from responses to the questionnaire in some more detail. In particular, members opinions regarding opportunities and constraints on the ‘road to market’ were asked – broadly in three sections which emerged from the background analysis and meetings with the NSG:

1) Market research and development;
2) Promotion and acceptance; and
3) Implementation and maintenance.

Feedback and data was used to draft aspects of the report, particularly section 6 which examines the 'road to market' in more detail.

1.3 Workshop with SMARTeST Partners

At a Project meeting in Delft in December 2010 a workshop was conducted with Project teams to assess broad trends according to disciplinary and national backgrounds. The workshop was loosely based upon a SWOT analysis (Strengths, Weaknesses, Opportunities and Threats) plotted in a matrix across a series of themes emerging from the background analysis:

- Regulation & public policy;
- Economic & financial;
- Social attitudes and (public) perceptions;
- Engineering and Technology;
- Geographic Scale; Capacity and resources.

Not only did this assist with the finalising questions asked in the National Review, but responses formed an element of the analysis itself. Respondents were also asked to provide a ranking of the most pertinent issues, helping the UNIMAN team to identify the themes that were of most critical importance for the drafting of the report, both with regard to external and internal integration.

1.4 The National Review

The team at UNIMAN developed a data-collection template for distribution by Project members entitled the National Review - essentially a meta-survey of characteristics of flood risk management and FRe across Europe. Teams were asked to consider a series of questions primarily with reference to their own national context, although there was also scope for broader contextual themes to be raised. This methodological tool formed a substantial component of the analysis. It was developed as a result of previous stages of research which all emphasised that the influences within each member state vary significantly and have an impact on implementation.

The questions were constructed with the help of a project workshop in Delft, the Netherlands, in December 2010 and in discussions with the UK NSG. In addition, in

developing the National Review templates, and in drafting the UK's National Review, the team at UNIMAN also conducted a series of interviews and discussions with a range of individuals from local councils, to consultants, to water and sewerage companies to emergency response agencies. Responses were used to further refine questions and to provide detail to the UK National Review.

The National Review template was refined into two broad sections. The first section examined existing responsibilities for water management, flooding and FRe implementation, whilst the second sought to identify national and sub-national drivers/ constraints for the use of FRe. A synthesis document comparing responses across all teams was also developed by way of summary for all Project teams. This is Part 3 of the report and should prove a useful resource for all project partners.

The National Reviews became the primary methodological tool used for this report. Responses were received from each Project member country: the UK (significant differences between Scotland and Northern Ireland were highlighted separately), Cyprus, France, Germany, Greece, the Netherlands and Spain. The team at UNIMAN provided an illustrative response on the part of the UK (primarily England and Wales) to help guide fellow Project members toward the most pertinent themes and issues.

Project teams were asked to collaborate with their national industry in drafting their response to the National Reviews. They were also asked to liaise with their contacts and with NSGs in considering certain questions. Particular emphasis was placed on those relating to the road to market and the process and circumstances of innovation, given the commercial composition of most of these advisory bodies. In conjunction with Project teams and Work Package leaders, one or two people in each country were charged with prime responsibility for drafting their response to the National Review.

Project team members were consulted at various stages of the National Review development and implementation. For example, team members were asked to refine questions and to ask further questions regarding themes they believed were particularly important. After responses to the National Reviews were developed by teams, the team at UNIMAN conducted an initial analysis, which included a verification of some of the details of responses.

Table 1.1 summarises this process. Note that several of these steps were not discrete accounting for overlap in time-periods for several tasks.

Table 1.1 The National Review methodological process

Month	Process	Description
1-6	Background analysis	Literature analysis and scoping of key areas to focus on and exploring issues around integration
7-9	Development of first draft of National Review	Conducted against background of literature analysis and after liaison with NSG and Project partners
10-11	National Review piloting	National Review was piloted for the UK. Consultation with Project members on detailed questions continued.
11-12	Development of second draft of the National Review	Consultation with Project teams, workshop in Delft and reflections on pilot led to a revision of the National Review template
12	Launch of the National review template and distribution of UK example	The National Review template was distributed during the Project meeting in Delft, Netherlands. Advice on completion was provided. Team received final feedback on some details of the template. The UK National Review was distributed by way of an illustrative example
13-15	Completion of National Review for Project Partners	Each country involved in the project co-ordinated a response to the National Review in conjunction with colleagues.
15	Deadline for completion of National Reviews	An initial analysis of the reviews took place. Queries on some details were raised by UNIMAN and forwarded to Project teams for clarification.
15-16	National review analysis	Individual analysis plus meta-analysis in Part 3.
16-18	Drafting of Deliverable 5.1	

1.5 Conclusion

The initial background analysis and workshops established that the use of FRe would differ across the EU, particularly when considering the influence of regulatory, financial and cultural issues. This was a view confirmed by the NSGs, as, for example, the FRe sector emphasised how difficult it was to operate outside of their national boundaries. Therefore the National Review process was designed for each project partner to scope key issues and provides a mechanism to collect comparable data concerning both flood risk management and FRe. This was developed in partnership with project members, the UK NSG and wider stakeholders to maximise its potential impact. These comprehensive documents provide a lot of the raw data used in the report and have formed a cornerstone of Deliverable 5.1. The results of every National Review are synthesised in Part 3.

The methodology also provided insights into pursuing integration internally. The background analysis and project meetings organised by Work Package 1 emphasised how integration of disciplines and approaches is a problematic proposition. The consistency in research approaches designed, advocated and implemented across the project will go some way towards enabling integration, but responsibility still lies with people more than processes. It is here that project partners will need to be engaging with each other in the project in order to translate these theoretical synergies into practice.

2. THE RESILIENCE AGENDA

Paradoxically, given the vast rise in knowledge concerning flood defence, there is little doubt that across the world, populations are increasingly subjected to flooding, making it one of the most frequent and widespread natural hazards. This trend is reflected across Europe (White 2010), and is anticipated to increase if the implications of anthropogenic driven climate change and growing urbanisation hold true.

At its simplest level, the perceived lack of success in preventing flood events could be considered a complex series of governance failures – with an array of culpable stakeholders identified by the press and public, ranging from national governments to spatial planners to institutions with responsibility for management. Yet this view does not reflect the realities of flood risk management, which is affected by a series of drivers affecting both natural and built environments. These are intensifying risk over time, challenging normality and prompting a need for more innovative responses.

The view that some societal challenges are too complex to be resolved by standard, linear and analytical approaches has been long recognised. For example, Rittel and Webber (1973) dichotomized problems into two types: *tame* and *wicked*. Wicked problems, by their nature are multi-causal, dynamic, subject to ambiguity, and importantly, resist resolution. In addition to this inherent 'wickedness', the depth of *uncertainty* characterising many contemporary societal challenges was highlighted by Funtowicz and Ravetz (1991) who advocated a paradigmatic shift toward 'post-normal' science: situations where data may be limited and normal planning and decision making approaches may not be equipped to provide timely interventions. Owens and Owens (1991) have similarly questioned the effectiveness of traditional environmental policy and planning cycles, which may create implementation gaps that inhibit action, particularly where information is hard to quantify, problems are complex and the distribution of related costs and benefits varies both spatially and temporally.

One contemporary strategy to adapt to possible uncertain future risks is to become more *resilient* to dynamic change. For instance, in the UK resilience is held as a strategy to adapt to various complex societal concerns, from terrorism to climate change (Cabinet Office 2008). This concept has only recently come to prominence within the field of disaster risk reduction (Klein *et al*. 2004), yet has quickly gained momentum and influence within environmental decision making more generally. The concept of resilience is wide ranging, and may, for example, encompass institutions, governance processes, people and ecosystems (Godschalk 2003).

The concept of resilience refers to the ability of a system to recover from perturbation and shocks. It was a core concept of Holling's (1978) adaptive approach to environmental

management, which recognised that change and uncertainty is inherent in complex systems, thus management should aim more for resilience in the fact of change rather than a static view of stability. The concept has gained increasing traction in the study of socio-ecological systems (Gunderson and Holling 2002; Folke *et al*. 2005; Adger *et al*. 2005; Rockstrom *et al*. 2009; Costanza *et al*. 2000; Ostrom 2009). Although resilience has the potential to enable society to better cope with uncertainty and complexity, there is recognition that achieving resilience in practice requires more understanding of the barriers and opportunities that can play a role in enabling the transfer from theory to practice (White 2010).

In short, there is a need to better understand the barriers and opportunities that can play a role in enabling resilience to be translated from theory to practice, particularly as managing uncertainty through enhancing resilience is fast becoming one of the defining features of contemporary society. Incorporating resilience into environmental decision making is beset by broader difficulties, for instance understanding how it can be used from a strategic, perspective merging human and constructed systems. This also underlines the need to increase the capacity to understand the scope of the drivers of change that influence decisions and actions. The following sections investigate the main drivers behind the 'resilience agenda' with regard to FRe: climate change; rapid urbanization; the shifting sources of flood risk; and the Living with Water agenda. The report then investigates the need to move from fragmented approaches to governance ones.

2.1 Climate change

Whilst natural fluctuations in climatic systems are expected, there is now scientific consensus that human activities, and in particular the burning of fossil fuels, agricultural practices and land use change, are influencing the Earth's climate. Over the last 100 years the Earth has warmed at a faster rate than at any other time over the last 1,000 years (European Environment Agency 2004) with an average rise in global surface temperatures of around 0.75 ºC. It is predicted that this rate of warming will accelerate over the early part of the Twenty-first century. Over the next two decades an average temperature rise of 0.2 ºC is expected with continental land masses warming more quickly than the sea (Intergovernmental Panel for Climate Change (IPCC) 2007). Changes beyond this depend heavily on actions to reduce carbon emissions in the interim.

Given this uncertainty, scenarios have been developed by the IPCC to help understand how the global average temperature may change according to our actions to reduce climate change. But under each scenario, and in every part of the world, the temperature is set to rise and climate patterns will change, inevitably altering the relationship between

water and citizens. Indeed, the United Nations estimate that around 70 percent of disasters are now climate related – up from around 50 percent from two decades ago (Tibaijuka 2009). Whilst it is difficult to ascribe any *particular* weather event or catastrophe as being due to climate change, it has been recently estimated as 'very likely' that global anthropogenic greenhouse gas emissions substantially increased the risk of the Autumn 2000 flood event that occurred in the UK (Pall *et al* 2011). The uncertainty engendered by a changing climate has significant implications for our quality of life in the twenty first century and provides a key argument for moving towards more integral resilience of FRe.

In a bid to better quantify the possible effects of climatic changes, the economist Sir Nicholas Stern (2007) has argued that the financial implications of not tackling climate change are far greater than previously thought and that the cost of flooding in particular is enormous. Although the scope and scale of flood impacts may vary according to geographical location, in general cities can expect to experience the following effects (IPCC 2007):

- heavy precipitation events will become both more intense and more frequent;
- a rise in sea levels during the twenty first century of approximately 0.2 to 0.6m;
- natural disasters, such as flooding and storms, to become much more commonplace and severe; and,
- increased runoff and earlier spring peak discharge in many glacier and snow-fed rivers.

Whilst the impacts of climate change will vary, it is likely that there will be a net annual cost that will increase over time. For example, the most current report from the IPCC (2007) states with a high degree of confidence that Northern Europe will be gradually subjected to increased flood risk as precipitation patterns intensify. These figures provide a compelling argument for the need to build more flood resilient cities, where buildings and citizens are better adapted to uncertain climatic extremes.

2.2 Urbanisation

By the year 2000 75% of Europeans had chosen to live in urban areas, and by 2020 it is anticipated that in seven European countries over 90% of the population will be urbanites (European Environment Agency 2006). One critical consequence of this growing urbanity is that the 'natural' hydrological cycle is heavily transformed by the use of land. It is now also recognised that it is now just urbanisation itself but *how* societies urbanise that create flood risk. In essence, the drainage of urban landscapes creates an urban water cycle, whose fast management of runoff has helped surface water flooding to become an almost entirely *unnatural* – and often a new - source of flood risk. Impermeable city

surfaces perform as a multiplicity of complex artificial water pathways, often seeming rather chaotic in their operation. Urban streets, footpaths and roads themselves become an element of the drainage infrastructure, and like any system this can fail under stress. Urban areas already prone to flooding, could therefore, expect a higher incidence and intensity of event, whilst escalating populations and the resulting urbanization could make many cities newly vulnerable to flooding, caused by intense precipitation events and overloaded, poorly designed and therefore inadequate sewerage and drainage systems. For instance the Cypriot National Review specifically refers to a media portrayal that a lack of infrastructure, poor maintenance and bad design exacerbates flash and coastal flooding in particular.

It is accepted that climate change and urbanisation will exert a significant, yet elusive, escalation of risk, undermining any approach based around defending against water utilising hard defences situated alongside rivers and coasts. This quandary may be understood as challenging the principle of *stationarity*, a central tenet around which the analysis of hydrological time series is founded. Whilst it may be expected that precipitation varies daily, seasonally and annually, over a longer time series it has been assumed to be stationary – that is one record should be comparable to another (Zevenbergen *et al.* 2010). This data has informed traditional flood defence and drainage strategies, underpinned conventional processes of decision-making and has supported engineering and technocratic approaches to flood defences. Yet urbanisation and the resultant risk of surface water flooding transferred the threat of inundation to include the urban environment away from the waters' edge, a changeable and expanding space which alters over time, often significantly, injecting further uncertainty into the governance of flooding (White 2010). Further, considering the aforementioned unpredictability of climate change, the application of a static, conservative methodology to highly dynamic urban environments can underestimate the scale and scope of the threat from flooding due to a failure to recognise and incorporate the many drivers that alter the properties of a system.

2.3 Shifting Sources of Flood Risk

Despite popular perceptions, flooding cannot be considered a homogeneous risk. A simple inundation of land may be the common result of flooding, yet there are an array of distinct, spatially variable sources, each subject to differing drivers which are rarely analogous. These range from the well-understood threats emerging from rivers and the sea to emerging risks that tend to be less well understood, and perhaps contested, such as urban runoff, infrastructure failure and rising groundwater levels. Each source demands differing adaptation strategies, introducing yet further complexity into flood risk management strategies.

This plurality of the flood risk sources, combined with deep uncertainty regarding the threat of flooding itself, undermines the long-held hegemony of large-scale flood defence, and provides a forceful argument for increased resilience. For example, in 2004 in England there were an estimated 80,000 homes at risk from surface water flooding (Evans *et al*. 2004), a figure that was then revised to 3.8m households in the space of five years (Environment Agency 2009) after the wide-scale summer 2007 floods inundated vast areas previously considered as 'safe'. This stimulated a recognition that, to date, scientists and policy makers had concentrated on compiling information on the risk from coastal, estuarine or fluvial sources of flooding, yet there was less knowledge concerning the flood risk from other sources, particularly from surface water and inadequate drainage (Pitt 2007). This realisation has further undermined conventional flood defences. How, then, can society manage flood risk when not only may traditional hard defence engineered approaches be irrelevant to this risk, but there may be potentially hundreds of separate multiple sources of risk that defy quantification? This plurality and complexity prompts the use of a diversity of systems and increased resilience in addition to large-scale flood defences.

It may be that the experiences of policy makers in England, whereby damaging events demanded reviews, which in turn led to calls for more sustainable and resilient approaches, can provide salutary lessons to differing areas subject to similar climatological and societal drivers. This is particularly relevant where there is a heavy focus on pursuing 'defend the line' approaches. The difficulties presented to the flood defence approach relate to the ability to accurately predict how precipitation will interact with the built environment. For example, how will the water pond or flow? What size of event will trigger dangerous levels of runoff? Which spatially discrete location will be exposed? How will climate change and urbanisation affect this? But all these questions should be considered in the context of the dominant managerial paradigm of the time - if both the volume of runoff and the areas that generate and receive it are unpredictable, irregular and multiplex how do you respond via structural measures? In short, how can a society adopt a 'defend the line' approach when a line can't be identified?

This shift in risk and the constraints of knowledge are important as within the space of a few years the management of surface water and drainage within cities has emerged as a major threat. Part of the reason for this deficiency is that surface water flooding is an extremely difficult source of risk to both diagnose and manage. Indeed, recent intra-urban flood events across Europe exposed gaps in knowledge in many countries; prior to which it may be understandable that no reliable figures were kept on the extent of this risk, partly due to both the complicated governance and management of surface water and emergent nature of the threat. The uncertainty evident in accurately identifying risk and managing impacts strongly argues for a more resilient urban form able to withstand and adapt to natural hydro-climatic variations.

2.4 Living with Water

A succession of flood events across Europe, combined with a rising awareness of the difficulties in effectively managing water has led to a recognition within many nations that the *prevention* of flooding is an unrealistic aspiration. The long-established 'flood defence' paradigm was no longer completely effective given the newly acknowledged uncertainty of flood risk, and the sheer logistical and economic burdens of large-scale flood defences. Consequently, there has been a distinctive shift towards *flood risk management* – an alternative, more comprehensive approach that aims to not only reduce and mitigate risk, but to consider wider human and socio-economic factors.

One logical way of reacting to this rise in uncertainty inherent in threats from flooding is to make the population of cities more aware of, and resilient to, flood risks. The wider realization of the practical problems in providing an effective defence against floods has recently helped to usher in a new narrative that must ecognize the limits of technocentricity as an absolute method to control water. This alteration is reflected in the pragmatic tenor of recent policies with impulsions to 'learn to live with rivers', 'live with the risk' and 'make space for water' (Institution of Civil Engineers 2001; Environment Agency 2005; Defra 2005). This has been reflected in other countries such as the related 'room for the river' guidance released in the Netherlands (Ministry of Transport, Public Works and Water Management, 2006). The European Flood Directive reinforces this wider view advocating a focus on *prevention, protection,* and *preparedness,* in addition to more effective emergency response and recovery (EU 2007). These measures, which can complement existing engineered approaches, also underline how flood risk management also encompasses consideration of measures that can be taken both before and after and flood, such as the four A's: *Awareness*; *Avoidance; Alleviation;* and *Assistance* (Ashley *et al* 2010).

This transformation has a series of critical implications. For instance, 'simple' relationships of responsibility between the State and its key managerial organizations have unravelled. The 'living with risk' agenda, within which prevention is pursued alongside an ability to cope with any possible impacts, could be pursued across multiple scales and professions; including the public sector, the private sector, building owners and managers, communities, households and individuals. As the challenges of flooding are exacerbated by forces beyond the control of any one agency there was a commensurate onus on responsibilities to be shared. The implication of devolving power and responsibility from the State towards communities and individuals is still emerging, obviously the new array of agencies and the expansion of spatial scales may create a fragmented environment for FRe to operate in.

2.5 The 'multi-level' safety approach

Although the consequence of an excess of precipitation, floods can be exacerbated through the activity of government, private parties and the actions of the public. The choice of location of properties and development, the capacity and installation of infrastructure such as drains and sewers, and construction methods all have an impact upon a flood event, including the extent of any potential damage caused and recovery from it.

An example of the recognition of this comes from the Netherlands where, after pluvial flooding in 1998, the committee *Tielrooij* was appointed to investigate the current status of water management systems in the Netherlands. In their report 'Water management in the 21st Century', the committee argued that the water retention and detention capacity was insufficient (Tielrooij, 2000). There is a debate in the Netherlands about whether urban development should be allowed in deep polders (up to 5 or 7 meters below mean sea level) and in unprotected areas along rivers (outside the areas protected by rivers dikes). Most developments in areas outside river dike protection have stopped; while some projects, for instance in the city of Dordrecht, investigate innovative solutions for building in these areas, such as floating buildings. Another solution that was developed in this context is so-called 'super levees'; essentially very broad dikes that function as ground for urban development.

Against this context, the Netherland's *National Water Plan* (Ministry of Infrastructure and the Environment 2010) distinguishes three layers of intervention, otherwise known as the *multi-layer safety approach*:

1. *Prevention* - particularly through heavy engineering such as land embankments and major drainage projects;
2. *Spatial planning* - including non-structural and land use planning measures, most importantly those 'behind the dikes';
3. And *disaster control* or emergency management - including evacuation plans, early warning and disaster training.

Both across and within this multi-level context, it is acknowledged that a wide variety of public and private stakeholders hold vested interests and maintain variable degrees of influence. For example, for large scale dyke construction, provinces, Rijkswaterstaat (the executive body of the Ministry of Infrastructure and the Environment and water boards are the primary stakeholders. Turning to spatial planning, municipalities again assume considerable authority in the creation of zoning plans. Traditionally, coping with flood risks in 'undefended' areas was achieved by surface level increases, but reduction in the costs

of flooding can also be found in adjustment of designs of dwellings. Here, project developers, home owners, construction firms, municipalities and architects all play a role.

The MARE project, 'Managing Adaptive REsponses to changing flood risk' was selected as a national policy pilot on the multi-level safety approach. The Netherlands national government commissioned partners to study the possibility of combining measures stretching across the aforementioned multi-levels in spite of being traditionally managed separately and with a dominance of flood prevention techniques. The Learning & Action Alliance in MARE is also pioneering efforts to surmount cultural and technical silos.

The multi-layer safety approach assumes a similar theoretical basis to a vulnerability study by De Graaf (2009). Here, a conceptual survey was conducted to identify how vulnerability was composed of four inter-related elements:

- *Threshold capacity* - the ability of a society to build capacity to withstand damage;
- *Coping capacity* - capacity to reduce damage in case of a disturbance that exceeds the damage threshold;
- *Recovery capacity* - ability to recover to the same or an equivalent state as that before disaster;
- *Adaptive capacity* - the capacity of a society to anticipate on uncertain future developments. This includes catastrophic not frequently occurring disturbances like extreme floods and severe droughts.

This framework demonstrates how vulnerability elements are connected: the alteration of one vulnerability capacity impacts upon one or more of the other capacities. A consideration of these four vulnerability aspects facilitates a more nuanced understanding of resilience to water and climate related threats and ultimately assist in the developing strategies to reduce vulnerability at multiple scales across a catchment or system.

However, despite the Netherlands witnessing a gradual move toward holistic flood risk management, flood *prevention* (possessing a long history in the country) remains the primary governmental approach. Therefore, current strategies for water supply and flood control management mainly focus on the first capacity of vulnerability by increasing threshold capacity. Illustrating this, a recent study concluded that only prevention is adequately defined and elaborated in detail, whilst other aspects are used only sporadically (Masskant & Hoss 2010). These strict preventive standards in the Netherlands render measures in spatial planning and construction (e.g. relocating, flood-proofing) and emergency management challenging, or even seemingly unnecessary in some instances.

Although the Netherlands provides a bench mark in respect to multi-level approaches to risk, other countries apply similar techniques, though often not with the same rigor nor as comprehensively. The UK National Review reports that planning policy aims to ensure that risk is taken into account at all stages in the planning process, to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas at highest risk. Where new development is necessary, policy aims to make it safe without increasing flood risk elsewhere and where possible, to reduce flood risk overall. Similar to the Netherlands, the overriding approach is *avoid* and *reduce* flood risk. Only if flooding is unavoidable should risk be *managed*. Therefore, FRe is theoretically necessary as a last-resort, as ideally new developments are risk-free. It should also be noted that planners only have influence over new developments or redevelopment – yet much risk is already embedded, requiring retro-fitting. More thoroughly, in Scotland, in the wake of the *Water Environment and Water Services Act* (2003) the Flooding Issues Advisory Committee have pursued 'sustainable flood risk management strategies' namely through the '4As'. These are:

1) To raise *awareness* of flood risk; not least amongst political and administrative decision-makers, professionals, and stakeholders including the public.
2) Where possible, to *avoid* flood risk by limiting damage through building adaptation in properties and buildings and building capacity in individuals and institutions to become more resilient.
3) By *alleviating* the effects of flood through the application of physical, technical , non-structural and
procedural measures;
4) And finally, in the event of a flood, to provide *assistance* to prepare for recovery in the event of a flood; providing support. [1]

Similarly, the France National Review reports how alternative approaches to risk management are being pursued that take into account vulnerability reduction. For instance, the DDT has developed a survey about vulnerability issues and methods on a territory considered by the central state as having an important potential of development (Opération d'Interêt National). Planners in charge of this area are now involved in a permanent discussion about how to reduce the vulnerability, while constructing in the area. These developments have positive effects because of the increasing number of competent stakeholders (at least claiming a responsibility in the flooding management). For instance, due to the decentralization process, the regional and county councils have become sources of information or incentives for the uptake of FRe.

[1] See Ashley et al. (2010) for a more detailed discussion of this.

Finally, established in 2002, the *Thames Estuary 2100 Project*[2] aims to adapt the Thames floodplain to the increased threat of (future) tidal flood through proposals that encompass a blend of traditional flood defence structures with an attempt to adapt to uncertainty in a sustainable fashion. The Project acknowledges that although it is unlikely that new defences will be constructed before 2070, current defences (including the Thames Barrier) should be upgraded from 2030. Supplementing this approach the Project also proposes that spatial planning and emergency preparedness has a critical contribution to risk reduction, most particularly regarding developments on the flood plain.

Not only does such work draw our attention to how resilience may be achieved in a more holistic sense, it also provides a reminder that the deployment of a set of FRe measures and systems at one scale does not preclude action or the further application of FRe at other scales too. Technology can be combined with non-structural measures to provide a smart, integrated approach.

2.6 Conclusion

Flood risk and a recognition of the uncertainty inherent in the management of any complex system provide a compelling argument for engagement with adaptation and resilience agendas by all those connected with the natural and built environments. If water cannot be kept out of properties by large scale defence works, then people and places will need to take alternative action to protect against flooding. Flood resilience is viewed as a key idea to operationalise the living with water agenda and mitigate risk. FRe may not just include resistance measures to keep water out of a building, but resilience approaches can also reduce the time for any repair if inundation does occur, helping limit the effect of both places and people. Therefore, resilience is critical for three interconnected reasons: its ability to *address uncertainty*; its potential to *minimize impacts*; and in facilitating *capacity to respond* to flood events (White 2010).

The challenges of flood risk management and the shifting agendas produced by political and societal drivers have implications for the current and future safety of citizens and the prosperity of places. But the Living with Water agenda is still emerging, and for FRe to be implementable across Europe attention will need to focus on integrative policies and practices to help reduce barriers to use and to smooth the road to market. It is here that the SMARTeST project is placed: aiming to integrate previously fragmented approaches and help translate the emerging EU policy narrative into practice.

[2] See http://www.environment-agency.gov.uk/homeandleisure/floods/104697.aspx for further details.

Integrated methods to address flood risk incorporate an array of technologies, systems and tools relevant to both new developments and the retrofitting of resilience into existing areas. Such integrated approaches require new strategic thinking about multi-functional approaches to flood risk management. In turn, this needs better communication between many different professional groups and new design and planning processes to encourage innovation. Approaches advocating measures such as awareness, preparation or multi-level strategies demonstrate how the narrative has moved towards integration. Effective communication and engagement can help develop intervention mechanisms appropriate to individual urban areas, cognizant of localized restraints and conditions but this may not be easily achieved in practice. Shifts in flood risk management from rigid, hard engineering approaches to adaptable, flexible FRe approaches require a concomitant development of social and governance aspects.

It is a well recognised phenomenon that changing behaviour is difficult and defies a simple linear approach of providing more information to encourage change, and the implementation of FRe, as with any other sustainability orientated change, requires not just changes in individual behaviour, but quite different norms and behaviour across a range of institutions and levels of scale (Darnton *et al*. 2006; Doppelt 2003; Kollmuss and Agyeman 2002; Shove 2010). This will require a significant increase in effort and understanding of how different actors perceive risk and potential responses to it. Member States will need more resilient institutions, professional networks and informal community networks in addition to adaptive infrastructure in order to build resilient urban areas. The following section provides more detail on the required shift from fragmented to integrated approaches.

3 FROM FRAGMENTATION TO INTEGRATION

3.1 Integration, FRe and SMARTeST

To make the Living with Water agenda a reality requires consideration of differing ways of managing flood risk and new partnerships to be developed – both externally with regard to implementing FRe, and internally within the project regarding integrating disciplines and knowledge.

In essence resilience demands new ways of working and may be understood as a move from a *fragmented* managerial approach to a more *integrated* one, where multiple stakeholders play mutually reinforcing roles. This trend has already been championed in the field of water management as a whole. For example a key rationale for the Water Framework Directive (European Union 2000) was highlighted by the World Water Council (2000: 1) who argued that: "*a holistic, systemic approach relying on integrated water resource management must replace the current fragmentation in managing water*". Similar to the Water Framework Directive, the recent Floods Directive (European Union 2007) has helped drive integration. This addressed the issue of fragmentation by advocating, amongst other measures, high quality, comprehensive flood mapping and assessments in all Member States, better co-ordination in shared flood risk basins and strengthening the ability of more stakeholders to influence management measures. The German National Review reports that these two Directives mean that flood risk management planning will no longer merely address engineering aspects of flood defence, but is a complex land-use and management concern that requires an interdisciplinary approach and stakeholder participation. Whilst the Floods Directive does present a policy framework within which FRe could operate, to do so may require complementary research and good practice, which has provided a key driver for the SMARTeST project.

Increasing the quality and coverage of data to enable this to happen is seen as central to improving evidence based approaches within environmental management in general (Carpenter 1995). Success in meeting the goals of policies such as the Water Framework Directive and the Floods Directive does not, however, hinge simply on the provision of more accurate and comprehensive data. Nations are not just suffering from a lack of data in attempting to 'plan for resilience' in the water environment; they may also experience a relative *data-rich but information-poor* syndrome (de Pauw 1996). This phenomenon may be a recent development, where the volume of data is greatly increasing but it is of limited value unless it can be used in decision making tools and processes. For example, Wilson (1998: 269) argues that:

> *"Access to factual knowledge of all kinds is rising exponentially while dropping in unit cost. It is destined to become global and democratic... What then? The answer is clear: synthesis. We are drowning in information, while starving for wisdom. The world henceforth will be run by synthesizers, people who are able to put together the right information at the right time, think critically about it, and make important choices wisely".*

The sustainable management of water requires integrated planning (including land use and other non-structural measures and systems), recognising the interconnections between systems operating at different tiers, and the dynamic interactions of multiple stakeholders in a complex environment. This is particularly the case when dealing with uncertain phenomena, where changes are spread across scales and time and dispersed in a way that is difficult to predict and to measure accurately. The European Sustainable Cities & Towns Campaign (2003) recognises that this lack of integration at many levels, including a lack of common vision is a key challenge for sustainable urban management. Alternatively, integrated planning (and assessment) "*aims to combine environmental, economic, social and cultural dimensions with spatial development*" (Ravetz 2000: 227) – this is an approach that reflects the nature of the SMARTeST project as a whole and will challenge integration both *internally,* within the project partners, and *externally,* linking these results to flood risk management and FRe. The shifting sources of flood risk and the failure to adequately protect people and places have undermined the flood defence approach and opened the door to the promotion of flood risk management – a change in emphasis where new sectors, professions and stakeholders all play a role. It is within this developing fragmented governance context that emergent flood resilience approaches must be considered.

In short, this means firstly, that the scientific community need to communicate more effectively. Secondly, and equally, the sustainable management of water also requires integrated planning, recognising the interconnections between systems operating at different spatial scales, and the dynamic interactions of multiple stakeholders.

The SMARTeST project recognises this need for a duality of integration; both scientifically and within FRe practice more generally. Table 4.1 outlines how the Work Package is designed to pursue integration in these two different ways.

Table 4.1 Internal and External Integration

INTERNAL INTEGRATION	**Issues connected with helping the Project to function. Whilst individual technology or decision making tools can help the implementation of FRe, these measures can be mutually reinforcing whereby, for example, one element of the system could be integrated with others to help embed smart FRe within urban areas subjected to differing risks. In this way a 'smart' approach would be more than the sum of its parts, demanding greater communication from project partners.**
EXTERNAL INTEGRATION	**This will first look at integration vertically, over the varying scales that FRe can be considered. Integration is also analysed from a horizontal perspective, including the array of agencies of influence. By considering the views of these wider stakeholders the project can help the integration of FRe into practice.**

3.2 Internal integration: linking technology, systems and tools

Deficiencies with fragmented decision making, large-scale structural approaches and data and modelling capabilities have all highlighted that the complexity and uncertainty of flooding calls for greater resilience, which in turn places demands on the governance of both flooding generally and FRe more specifically. As the problems associated with piecemeal approaches to the alleviation of flood risk are better understood, there has been a general movement towards integrative approaches. Yet integration itself is complex and multi-dimensional. One of the challenges of the SMARTeST project as a whole is to recognise the problems of fragmentation and be proactive about integration between work packages and member states. With regard to this project, internal integration can be thought of as consisting of four interlinked sectors, each of which are explored in Work Packages 2, 3, 4 and 5 of SMARTeST:

- integration of FRe *technical* responses;
- integration of FRe into the wider *system*;
- integration of FRe into decision making *tools;* and,
- integration of FRe into *implementation* processes.

The first of these integration requirements is well understood, and comprises the infrastructure developed to manage flooding; in the past it has, however, tended to be dominated by large-scale engineered defences. More recently, technical approaches to flood risk management have been expanded to include non-structural methods and smaller-scale FRe technology that could operate either behind, or instead of, traditional flood defences. Work Package 2 of SMARTeST is designed to explore the technical aspects in more detail. In particular the use of 'smart' or innovative FRe will be examined.

With respect to the second issue, a drive to consider the influence of the wider urban *system* within flood risk management has been recognised within both academia (White 2010; Zevenbergen *et al*. 2010) and encouraged by shifts in policy, such as the Water Framework Directive and Floods Directive (European Union 2000; 2007). This outlook would include aspects such as the natural and artificial characteristics of hydrology determined by the use of land, built environment and ecosystems within the urban area and the wider catchment. It would also consider those 'human' elements of a system that can reinforce technical aspects. More research concerning how a more holistic understanding of the urban system, including the consideration of how the integration of multiple FRe technical measures may be considered will be explored in Work Package 3 of SMARTeST.

Pan-European flooding incidences have also shed light on the potential influence of data and modelling *tools* and their subsequent impact on decision making. Advances such as better science and spatial visualisations can help operationalise smart FRe resilience, whilst the benefits of early warning and emergency responses can assist in reducing damages. Likewise, the time of deployment of temporary structures is a critical feature in relation to warning time, whilst the prevention of failure of components, especially when used at low frequency, is important.

Yet decision support within this complex arena needs to consider how these tools can best be used to improve the management of flood risk from a system perspective; this would include both the utilisation of smart, innovative technologies and their application within the urban environment from a strategic understanding. The usefulness of decision support tools in practice is limited in their actual support of decisions. They can be useful during project development to visualise different scenarios and solutions and their effects. When it comes to decision making, this is a complex process involving many stakeholders in following a series of procedures and decisions. In this process, decision support tools are rarely used, probably because the decision process is too diffuse and involves too many steps to identify decisions where the tools would be useful. Work Package 4 of the project will develop decision making tools specific to FRe and explore how these can be best applied within differing urban areas.

Equally, as highlighted previously, involving individuals and other stakeholders in managing and adapting to flood risk both helps to develop effective solutions and facilitates their practical implementation. The Living with Water agenda must engage with communities exposed to risk and expected to be resilient. Their views and efforts may be integrated with consideration of smart technology, urban systems or decision making tools in order to assign ownership and promote wider responsibility. In addition to an acceptance of FRe, communities can also play a role in managing flood events, which could both exacerbate or mitigate matters. The consequences of these alterations need to be better understood. This is increasingly important as smart technology at the building or street level may be directly deployed by citizens, often supplementing other smart technologies deployed at the municipal, regional or state scales.

As occurred with the translation of the Water Framework Directive into practice, flood risk professionals need to engage with different stakeholders to merge resilience science and practice together effectively. Engaging with different stakeholders can also be pragmatic; it is easier to get community-scale FRe installed and to encourage new behaviour and acceptance of new practices if all pertinent stakeholders are included in decision-making. On a more fundamental level, however, this move towards resilience implies developing an ability to adapt, to communicate and to foster a culture of innovation both in FRe practice and the processes that frame the agenda and establish the context for implementation. Research examining the integration of FRe into communities and wider stakeholders will be conducted in Work Package 5.

Internal integration can therefore be seen as a process from an initial fragmented disciplinary and scientific outlook, towards one where gradually partners explore how independent approaches can achieve beneficial synergies. This goal will be pursued throughout the project and although Work Package 5 will outline key principles in the final section of this report it is the responsibility of all partners to act on them.

3.3 External Integration: vertical and horizontal approaches

In the EU the defence against flooding has historically been pursued by arrangements between the state and the public, brokered by strategic level organisations that attempt to manage flood risk through the construction of large-scale engineering-led solutions. A defining feature of this traditional approach has been the limited number of actors and agencies involved in the decision making process. Protection has been overwhelmingly determined and operationalised via a technocentric, paternalistic paradigm within which the costs of construction were weighed against the number of properties protected. In effect, many wider influences were segregated away from the management of flooding with the remit placed firmly in the hand of the ‘expert’ assigned by the state, with cost-benefit analysis methods used to help prioritise spending. This view paid little attention to

the opinion of citizens and other stakeholders who could positively contribute towards this goal.

Table 3.3 Summary of Vertical and Horizontal Integration Aspects

VERTICAL INTEGRATION	**Vertical integration may be defined as the entirety of governance from the EU, to the Nation State, to Local Municipalities to the community. Ideally, the achievement of integration in this context would entail the assimilation of efforts both within and across scales, merging 'top-down' and 'bottom-up' approaches, for instance, to form a concerted promotion of FRe. In addition to co-ordination across spatial scales, integration must also consider the co-ordination of multiple, and sometimes contradictory, policy frameworks in operation.**
HORIZONTAL INTEGRATION	**A move toward horizontal integration complements the vertical approach. It includes a consideration of the views of all the wider stakeholders who can play a role in FRe. Previously, the main agencies with power over facilitating the management of flooding were formal, usually statutory, organisations with almost sole command over financial resources and decision-making. But to achieve better integration necessitates the inclusion of many further stakeholders, including built environment professionals, land managers, the construction sector, the development and finance sectors, the insurance sector, the public and those companies who design and sell FRe technology. Through their co-ordination and co-operation, the 'road to market' for smart FRe will be less contradictory, complex and problematic.**

The wider array of scales and agencies that now play a role in flood risk management requires improved integration of practices and processes; this is particularly the case for FRe which is an emerging approach. The National Reviews revealed that problems affecting FRe from across the EU could be categorised as occurring from both fragmented spatial (scales of influence) and sectoral (agencies of influence) aspects - therefore to provide more conceptual clarity the external integration of FRe was considered in both *vertical* and *horizontal* terms; a classification which is used to encompass the entirety of governance influences and the actors who operate within it. Table 3.3 provides a summary of this approach.

A move toward horizontal integration complements the vertical approach. It may be defined as a diversification of influence to incorporate all those wider stakeholders who can play a role in FRe. Previously, the main agencies with power over facilitating the

management of flooding were formal, usually statutory, organisations with almost sole command over financial resources and decision-making. But to achieve better integration necessitates the inclusion of many further stakeholders, including built environment professionals, environmental and land managers, the construction sector, the development and finance sectors, the insurance sector, the public and those companies who manufacture and sell FRe technology. Through their co-ordination and co-operation, the 'road to market' for smart FRe will be less contradictory, complex and problematic.

Figure 3.1 details why the shift in approach from flood defence to flood risk management demands consideration of both *vertical* and *horizontal* integration. Instead of a simple process involving one key agency determining large scale flood defence spending, FRe has to integrate into an environment occupied by multiple agencies operating on differing spatial scales. These key stakeholders and spatial scales will be explored in more depth in the following two chapters and are key framing devices to be used throughout Work Package 5.

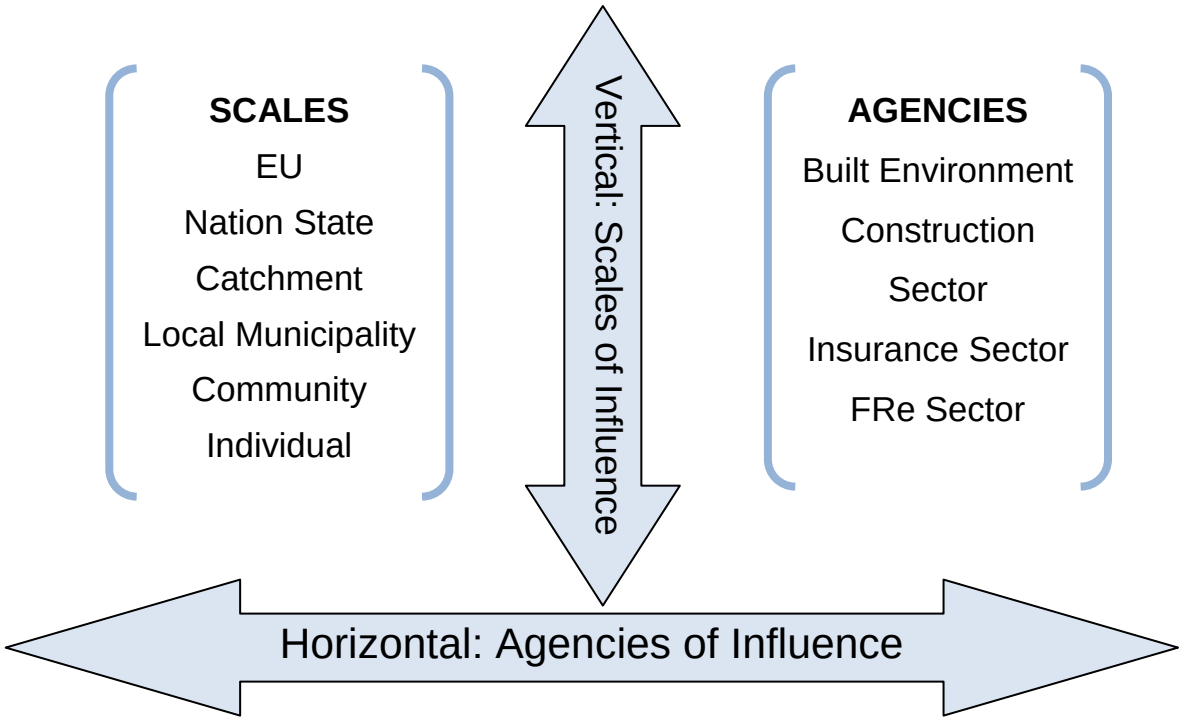


Figure 3.1: A representation of horizontal and vertical integration in FRe, detailing the key scales and agencies with influence.

3.4 Conclusion

In summary, this project is designed to pursue integration in a number of ways. It will first look at integration vertically, from the structural defence protecting a town to technical measures that can be applied across the urban system. Integration is also analysed from a horizontal perspective where a much wider array of decision making tools and stakeholders can influence the approach taken. Consideration of the need for integration across the technical, urban, decision making and engagement systems helps address many of the current problems in operationalising resilience within flood risk management.

Issues connected with helping the project to work internally are also discussed. Whilst technology or decision making tools can help FRe be implemented when considered individually. Significantly these measures may be mutually reinforcing whereby one element of the system could be integrated with others to help embed smart FRe within urban areas subjected to differing risks. For example, improved decision making practices could ensure that the most appropriate technology is placed in the area of the urban system where it can be most effective given the local hydrology and the communities at risk. In this way a ‘smart’ approach would be more than the sum of its parts. It is beyond the capacity of this Work Package to ensure that this integrated approach happens but it will highlight critical areas and facilitate conversations between partners. Ultimately it is the responsibility of the entire project to integrate findings, but the final section does provide an overview of key principles that can aid integration.

The following two sections use the framing concepts of vertical and horizontal integration to highlight and analyse the various influences affecting the implementation of FRe.

4. VERTICAL INTEGRATION

Figure 3.1 illustrates how the shift in governance from flood defence to flood risk management demands both vertical (the scales of influence) and horizontal integration (the agencies of influence). This section examines matters arising for the 'vertical' integration of FRe. It primarily does so by examining opportunities and constraints produced *within* and *across* spatial and governance scales – from Europe, to the Nation State, to Local Municipalities to the community. Ideally, vertical integration in this context entails merging 'top-down' and 'bottom-up' approaches, forming a concerted promotion and implementation of FRe. Theoretically, smooth co-ordination across scales and combined efforts to support FRe implementation within these tiers will underline systematic FRe integration.

4.1 Integration at the European Scale

This section considers issues around FRe tools, systems and technologies that emerge from the European Union scale of governance. Importantly, several of the themes raised here have a direct relationship with national governance and administration. They also touch upon themes of analysis that are of direct relevance to the primary stakeholders of FRe integration, and as such some of the points raised here shall be returned to later in the report.

Flood risk management strategies have evolved in EU member states at differing rates and to contrasting degrees with important implications for integration. As a result, it is widely acknowledged that the governance and management of water varies both in regard to 'physical measures and non-structural policy instruments' (Klijn *et al.* 2008: 317). Whilst differences are due partly to variations in river type and flood regime (a critical consideration given the geographical expanse of Europe), there are also socio-economic, cultural and historical circumstances. These are both reflected in and caused by institutional arrangements (Klijn *et al.* 2008; Mostert *et al*. 2007; Pahl-Wostl, *et al.* 2008).

Given the broad diversity of national circumstances, it is difficult to identify a definitive assessment of the flood risk management situation for Europe. It is, by consequence, also difficult to distinguish an agreed series of circumstances that may be able to support the systematic integration of FRe. It must also be noted that the themes discussed throughout this section are applicable to specific national situations to contrasting degrees. However, the analysis presented here identifies a series of issues that either inhibits or encourages the integration of FRe, or that will influence integration in the future.

The trends that have been identified are drawn not only from research conducted as part of the SMARTeST Project but also through academic literature dealing with environmental and risk governance.

4.1.1 The Background to European integration

It is impossible to appreciate the role of individual Member States in advancing or constraining FRe innovation implementation without first considering the considerable impact that the European scale of governance has upon national and local environmental policy and practice.

Although the Treaty of Rome of 1957 made no reference to the environment, the EU has since become a key driver of environmental reform within the Member States. There are now few areas of national environmental policy that are politically or legally exempt from EU requirements. This unique form of multi-level environmental governance creates both opportunities and constraints for Member State actors (Barnes and Barnes 1999; Jordan 2002).

Much of the complexity linked to this status stems from the broad and ambitious principles established by the Treaty of the European Union signed at Maastricht in February 1992. According to Wilkinson (2002), although the Treaty established a series of important principles for the multi-level nature of environmental policy, it left many of the concepts vague and the mechanisms for delivery uncertain. Of the over-riding themes of 'sustainability', 'high level protection', the 'precautionary principle' and '*subsidiarity*', it is the latter that is of central importance (Jordan 2000; Knill 2000; Estella 2002).

According to Article 3b of the Maastricht Treaty "*the Community shall take action, in accordance with the principle of subsidiarity only if and in so far as the objectives of the proposed action cannot be achieved by the Member States*". In other words, the EU will intervene in Member State affairs *only* when national arrangements are seen to be defective. The manner in which subsidiarity should be applied however, is dealt with in imprecise terms and it is not clear in what areas the EU should intervene and at what level of detail (Wilkinson 2002). This is partly the product of a desire at the supra-national level to allow Member States a significant amount of discretion in how they implement EU policy, but it also protects national structures and styles of governance. Whilst this accounts for European diversity, such flexibility also brings with it a significant amount of uncertainty both at and beyond the stage of legislative transposition. By consequence, emerging subjects such as flood risk management and with particular relevance to the SMARTeST Project the circumstances of FRe integration is marked by diversity and further uncertainty and complexity.

Linked to the challenge of subsidiarity is the degree of perceived *legitimacy* attached to European policy intervention. The extent to which EU policy measures are seen by Member States as both necessary and desirable will have a significant bearing upon legislative transposition and implementation. Scholars of multi-level governance usually refer to perceived legitimacy in terms of 'appropriateness' (Knill 1998) or 'issue salience' (Versluis 2004). According to Versluis, issues associated with risk or dramatic events are often considered more 'visible' and hence the intervention of the European Union possesses a greater degree of legitimacy. This generates a significant potential opportunity for FRe integration; however, as will be discussed later, the issue of legitimacy is also strongly related to the societal acceptance of the Living with Water agenda, a concept that has not been without reluctance.

In a practical sense, legitimacy is likely to depend on which Member States were involved in the formative stages of the policy process as well as generic national attitudes toward environmental concerns. If a State was central to advocating a particular innovation, then it is more likely they will see that intervention as legitimate. Several authors have drawn attention to a discreet north-south divide with regard to environmental policy. In crude terms, those States from the south are seen as having a less dominant role on driving EU level policy changes and often have traditions of environmental management which have made reform difficult (Pridham 2002). In contrast, many of the northern states, particularly the Netherlands, Germany and Denmark have acted as 'green motors' in pushing for change (Anderson and Liefferink 1997) and have often sought to model EU policy in accordance with their own norms and structures (Heritier 2002).

The final area of significance relating to EU policy impact is that of *implementation*. Barnes and Barnes (1999) have remarked that despite the increasing degree of intervention by the European Union in the environmental policy arena, a significant percentage of measures have demonstrated a sizeable 'implementation gap'. According to Jordan (2002), this is a result of an unfortunate 'pathology of non-compliance' in which the expansion of EU regulation has been constrained by an inability to delve substantially into national affairs. Arguably much of the problem rests in a misplaced faith in 'tiered' or 'top down' policy implementation. Inbuilt within EU policy is a belief that once a Directive or action is adopted, it will trigger appropriate action downstream (Barnes and Barnes 1999; Lowe and Ward 1998; Baker *et al*, 1997). A problem with this 'trickle down' policy perspective is that it does not account for complexities such as institutional structure, management capacity, knowledge, stakeholder conflict or financial resources. As discussed previously, FRe integration therefore needs to be both vertical, in that it has buy-in at all spatial scales, and horizontal, including all the agencies with the ability to influence.

From the above discussion, clearly the degree to which FRe integration can be effectively advanced within EU Member States will, to a certain extent, be dependent upon the nature of intervention by the EU over relevant national affairs. Whilst the EU has provided little formal advocacy for FRe system development, it has delved substantially into underlying themes, establishing a context that is critical in understanding the challenges to FRe adoption in a broader sense. The manner in which Member States have responded is discussed below.

4.1.2. Achieving European integration

The most significant EU policy development likely to impact upon FRe advancement within the Member States is Directive 2007/60/EC (the *Floods Directive*). The Directive emerged from concerns over the mounting societal cost of increased flooding activity within the EU from the late nineties onwards. Between 1998 and 2002 it is estimated that there were over 700 flood related deaths within Member States and an economic impact of over 25 billion Euros (EC, 2003). From the perspective of the EU, flood risk management aims to minimise the probability of flooding, and where it does occur, to limit its impacts. The 12 July 2004 Commission Communication to the European Parliament, the Council, the European Economic and Social Committee and Committee of the Regions proposes that the most effective approach to managing flood risk involves the realisation of the following five elements:

- **Prevention:** preventing damage caused by floods by avoiding construction of houses and industries in flood-prone areas; by adapting future developments to the risk of flooding; and by promoting appropriate land-use, agricultural and forestry practices;
- **Protection:** taking measures, both structural and non-structural, to reduce the likelihood of floods and/or the impact of floods in a specific location;
- **Preparedness**: informing the population about flood risks and what to do in the event of a flood;
- **Emergency response**: developing emergency response plans in the case of a flood; and,
- **Recovery and lessons learned**: returning to normal conditions as soon as possible and mitigating both the social and economic impacts on the affected population.

The Floods Directive deals the first three of these elements: the three ‘P’s of *prevention*, *protection* and *preparedness*, noting that managing flood risks across Europe requires concerted and coordinated action at Community level. This integration would in turn, it is hoped, bring considerable added value and improve the overall level of flood protection. On this basis, the Directive requires Member States to assess areas likely to be at risk of flooding, to map the extent of possible floods and to identify assets and humans at risk. This is returned to later.

As reported by all of the National Reviews, assessing perceptions towards the Floods Directive is difficult as most Member States are in the early stages of transposition. Nevertheless, early signals are that the Directive has been widely accepted in both concept and in practice. Although this is in contrast to experiences with earlier EU environmental directives (notably the Directive 85/337/EEC on Environmental Assessment), it is arguable that the centrality of 'risk' to the Directive has served to enhance legitimacy. This accords with previous findings on 'risk' and 'political visibility' (Knill 1998; Versluis 2004). Nevertheless, it is likely that the 'extent' of perceived legitimacy will be variable.

An important implication of the subsidiarity principle is the freedom for Member States to adopt different approaches to legislative development. The results of the National Review suggest that Member States have utilised this freedom to account for national circumstances. Whilst all countries have taken steps to ensure legislative transposition in line with the requirements of the Floods Directive, there is a significant level of variation in approach and in the impact they have had. These are characterised in Table 4.1. Such flexibility does, however, mask some of the wider challenges of subsidiarity.

One of the central assumptions contained within EU environmental policy is that diversity is compatible with Member State equity and harmonisation. Yet, as shown in the table below, Member States with less experience of integrated flood management (most notably Greece and Cyprus) will inevitably find the processes of transposition more costly and resource intensive than States with established flood management systems. Whilst in France, as in several other countries (e.g. The Netherlands and Germany), elements of the Directive are already common practice, where the French "action plans for floods" (PAPI) are compiled similarly to the Directive's flood risk management plans. That said, challenges to integration will also exist even in these rather more 'experienced' nations. There can be little doubt that in some nations the sheer complexity of governance arrangements may undermine the Directive's transposition, not least due to a degree of institutional congestion. Importantly, the Directive assumes Member States will work towards a joint standard of application.

Table 4.1: Member State responses to the Floods Directive

Category of response	Parallel integration	Partial reform	Restructuring
Attributes	Countries that have existing structures and processes in place which closely mirror the scope of the Directive. Overall impact of reform likely to be minimal.	Accounts for the majority of Member States consulted but contains two notable dimensions. A) Member States which can be seen to have already begun the process of policy transition towards integrated flood risk management but have used the Floods Directive as mechanism for formalisation. B) Those countries which have existing provisions which contain elements of the Directive but which require expansion and integration	Members States for whom transposition of the Directive requires substantial legal and institutional reform.
Member State examples	In the Netherlands, much of the apparatus of the Directive already exists and very few changes in flood risk management are likely to result from transposition.	A) Arguably, both the Pitt Review of 2007 in the UK and the German Preventative Flood control Act of 2005 predicted much of the tone of the Directive. B). Both the Spanish and French systems already upheld approaches to zonation and flood planning prior to the Directive but were not sufficiently integrated with other mechanisms or had a history of management failure.	Greece has limited formal experience of flood management and regulation requiring and is undergoing a substantial process of capacity building. Cyprus is undergoing a wider process of institutional restructuring as part of recent accession to the EU.

As has been detailed, some countries, such as the Netherlands and Germany, have reported that they are better placed to implement the changes induced by the EU Floods Directive. Yet, the vagueness of the text does not specify the extent of application, nor does it predict the disparities generated by legislative 'gold-plating'. Both the UK and Germany for example, have supplemented the Directive with a host of additional measures aimed at improving practice within related sectors. Most notably, these include improvements to building standards and revisions to land use planning provisions to ensure appropriate recognition of risk and resilience. However, whilst planning does

address these issues, building standards in England and Wales have not changed and still give only minor advice on flooding.

4.1.3 Achieving integration across scales

As has been discussed in Section 5.1 of the report, the presence of a sizeable policy 'implementation-gap' has long been a hindrance of Member State integration. A number of areas of consideration for integration across scales have emerged from an analysis of the National Reviews. Firstly, there is evidence of some Member States adopting the role of 'green movers' as discussed by Anderson and Liefferink (1997). The response from the Netherlands to the National Review indicates that much of the Directive was modelled around the provisions of the Netherland's system and that they played an active role in driving the detail of the Directive forward. Much of the motivation for this was an attempt to regulate trans-boundary pressures arising in neighbouring Member States. By linking the Directive to national and sub-national modes and norms, it is likely that the Directive will gain more ready acceptance within the Netherlands than elsewhere.

The second issue of importance relates to the link between supra-national governance and regionalism. Several European states have strong federal structures which distort the overall national picture. In both Germany and Spain, certain regions have already (often independently) demonstrated an active role in flood risk management or are developing innovative responses to the Directive. In the case of Spain, the Province of Valencia has upheld flood risk legislation since 1999, whilst in Germany both Rhineland Pfalz and Baden-Wűrtenberg have developed knowledge partnerships to deal with risk assessment, awareness, reduction and emergencies. In Greece too, many efforts to manage flood risk are derived from regional tiers of governance. Whilst these regional innovations can be viewed positively, they also do indicate that the legitimacy of European intervention will vary at both national and regional scales.

Limitations within the scope of the Directive were also highlighted as a substantial impediment to implementation. For example, a lack of clarity with regard to determination of flood risk zones was seen as a potential barrier in Spain. Specific mention was given to Article 5 which was seen as far too vague when discussing access to information. Of greater concern amongst German respondents was the lack of a clear audit or monitoring system to track implementation. This was felt to be likely to weaken not only policy implementation but also the push towards to FRe technology. On a similar note, the Cyprus National Review identified how an 'implementation gap' between spatial scales leads to a lack of action 'on the ground'. The German National Review also highlighted that implementation may be hindered by a lack of comprehensive indicators that can audit adherence to the Floods Directive's terms and raised concerns that this lack of monitoring will undermine FRe systems, technology and products implementation.

The overall implication is that practice across Europe is likely to become divergent and exacerbate differences between countries in terms of their capacity to act. Whilst this may make for a fragmented environment, it also creates the potential for best practice to be disseminated between countries, and perhaps for mutual learning to take place.

The difference between legislative transposition and implementation was a further theme recognised by the majority of Member States within the National Review. Collectively, it was argued that if the EU Floods Directive was to prove effective it would need to overcome a number of discreet practical barriers to implementation. The most common area of concern related to financial resources. In the UK, for example, the current Conservative-Liberal Coalition Government has stated a commitment to improve flood risk management provisions but has at the same time announced a 25% cut in central funding. It remains to be seen whether these twin policy positions are compatible. In the UK the Government has asserted that it expects local authorities, as well as the private sector, civil society organisations, and the public more generically to assume greater responsibility for managing flood risk. Similar observations were also expressed by Spain and Germany.

Member States appear to have mixed views regarding the impact of wider stakeholder involvement within flood risk management. In the case of France, improved provisions for local level consultation were perceived as a necessary measure for improving dialogue within traditionally centralised institutional frameworks. In contrast, such provisions were seen by Germany as one of the key limitations of the Directive. Particular reference was made to the degree of power which could be assumed by non-legitimate or 'vested' interests within the processes. This was thought to most likely be an issue where there is conflict between upstream and downstream interests. Several of these themes will be returned to in subsequent sections.

Many of the specific findings discussed above would appear to highlight the need for wider recognition of the importance of Member State capacity building to accompany legislative change. Mechanisms for improving national and lower level capacity are addressed in the workshop reports which will form part of Project Deliverable 5.2.

In summary, the EU can both facilitate and mitigate FRe integration. Whilst there is pressure to integrate on a strategic level having some national freedom may inhibit the potential of the private sector and FRe technologies to operate across national boundaries. The ease of policy implementation also differs spatially, fitting neatly into some existing frameworks, whereas other countries may require significant time and resources. This position may therefore strongly support the production of best practice to help close any implementation gap. Given this disparity across Europe, successful

vertical integration of administrative support structures for FRe require a clear understanding of national institutional arrangements, which is explored in the following section.

4.2 Integration at the National scale

This section considers the context of flood management and flood resilience tools, technologies and systems at national tiers of governance, administration and decision-making.

The governance dynamic between the nation-state and lower tiers of governance – and between all other tiers of administration for that matter – are in constant flux. Relations are fluid, with power and responsibility unsettled and varying over time, across issues, and as they rise and fall in reflection of their political imperatives. It is challenging, therefore, to definitively assess the consequence of administrative reform on the development and uptake of FRe. Compounding this situation, as detailed earlier, the EU Floods Directive has been only recently transposed into national countries. It has been reported from across Europe that these alterations remain uncertain as the full implications have yet to transpire.

4.2.1 Institutional and national co-ordination – or fragmentation

A common theme of debate across European countries regards the degree to which national governments are able to *lead* definitive action to address flood risk and in securing FRe integration. Several National Review respondents reported that the management of flood risk is fragmented, with limited institutional co-ordination ultimately undermining efforts to take action. Delineations of responsibility for leading policy initiatives may lack clarity whilst political and administrative forces create rather opaque governance machinery even at executive tiers of authority.

It was reported in National Reviews that responsibility for flood management was often split between agencies, and across governance tiers. This creates complexity and confusion regarding who should lead (and perhaps more importantly, finance) remedial works. Current administrative alterations in other Member States could currently generate even further fragmentation. For example, Greece recently underwent a major administrative change under the law of “Kallikrates” which led to the formation of new, larger municipalities deriving from the combination of the already existing municipalities (the law is in action since January 1st, 2011). The new municipalities now bear a larger responsibility area while reallocation of responsibilities and staff transfers are yet to be finalized. This results in a present lack of organization and time consuming procedures.

Equally in the UK, the lead Governmental body for general flood management is not in fact directly responsible for managing surface water flooding – which is the particular responsibility of local authorities and utility (drainage) companies. This situation is particularly pertinent given how surface water flooding is now accepted to be the most threatening type of flood facing communities in the UK (EA 2009). This fragmentation, and the sheer confusion it may generate, was recognised and critiqued by the Pitt Review in the UK, which argued for a clearer delineation of responsibilities amongst tiers of governance (Pitt 2007).

Additionally, there is little doubt that across Europe, the transference of flood preparedness into standards and codes is in its infancy. There is too, considerable discrepancy throughout countries in terms of the existence of regulations and legislation to comprehensively integrate FRe into the design and construction of buildings. In some places, such legislation does not exist at all, whereas in others where flood resilience is regulatory, stipulations may not be consistently applied or enforced across all sectors. Illustrating this, in England and Wales, the Flood and Water Management Act 2010 amended Schedule 1 of the Building Act 1984 to permit local authorities to impose a requirement of works to integrate features that “in so far as it relates to the resistance or resilience of buildings in respect of flooding” (S 41(1)). Although this would seem to be supportive of FRe integration, it is, however, difficult to assess just how effective this has been and if it has led to a change in practice. In Greece, there are no regulations with regard to FRe system and technology uptake. If necessary, regulations are usually set by the system manufacturers. It is a known fact that the Government in many cases adopts the manufacturers’ regulations and utilizes these as the required specifications which creates an unusual environment of trust. Although having only limited impact thus far, these developments have the potential to have a huge effect on FRe uptake in the future.

Not only do these situations further contribute to the complexities of risk governance across Europe, NSGs have critiqued a lack of consistency in approaches even *within* lead governmental departments. There are many agencies and bodies which have overlapping, conflicting or inconsistent jurisdictions with no overall coordination. For example, members of the UK NSG suggested that the Environment Agency publish conflicting advice on whether flood water should be ‘let in’ or ‘kept out’ of a building. Although the Living with Water agenda does not easily lend itself to such simplistic binary approaches to managing flood risk, this example was used on several occasions to illustrate the challenges of joined-up thinking in settling upon consistent flood management strategies.

There have also been reports that cumbersome administrative arrangements can limit pro-activity on the part of governmental agencies in responding to the threat of flood. France, for instance, reported that their Environment Ministry's territorial planning procedure is slow and is not comprehensive, whilst the Environment and Energy Régional Directorate (DRIEE) is hindered by administrative procedures that constrain efforts to embed FRe features. Even in countries where flood risk management is not a priority for the state, such as Cyprus, it is apparent governance is fragmented with many agencies having overlapping or inconsistent responsibilities, with a distinct lack of co-ordination. Moreover, in Cyprus the Water Development Department (WDD) is unable to promote FRe uptake, by licensing technologies or by forcing FRe to be used in buildings at risk.

In many European countries, the transposition of the Floods Directive into law and practice has been viewed as an opportunity to reinvigorate and reorganise national flood management agendas. The Spanish National Review reports that against a context of fragmentation, the EU Floods Directive will be beneficial because it will establish the basis for improvements in administrative coordination. In France it has been reported that the Government are replacing current fragmented policies with a more comprehensive national strategy for general flood management. In Cyprus too the WDD has recently been appointed to be the legally responsible public body for co-ordinating compliance with the Floods Directive. Importantly, this body is as yet not fully constituted; there are no regulations yet listing the responsibilities of the WDD and the ongoing practice regarding flood risk management remains fragmented. However, the WDD, which has increasing expertise and professional capabilities, will assume a greater co-ordinating role will help address current inconsistency with water governance. The Greece National Review similarly stated that a lack of coherency and organisational capacity, combined with a wide time-frame for the full implementation of national legislation including the EU Floods Directive, may hinder the integration of FRe technologies, systems and products.

Germany reports that recent efforts to prepare for flooding and providing flood protection can be traced to the year 2000, when the German advisory council on the environment (Sachverstaendigenrat fuer Umweltfragen) advocated more retention areas for rivers, cooperation between States, European cooperation, environmentally friendly use of rivers, better flood protection and early warning systems (Rehback and Hinsberger 2008). In 2005, in response to devastating flood losses along the rivers Elbe and Danube in 2002 the federal government passed the *Act to Improve Preventive Flood Control*. The Act reflected emerging concepts of flood resilience which gave state agencies the mandate to alter water laws and to implement a concept that revised flood defence to cover (i) land use control including floodplain mapping, (ii) flood preparedness, (iii) capacity building of stakeholders, and (iv) contingency planning. Critically, the Act was a change from traditional approaches to flood management representing a de-emphasising

of structural flood defence. The law was passed, even though the “German Advisory Council on the Environment” (Sachverständigenrat für Umweltfragen) had advised that the laws at that time were sufficient. The federal government felt that a law would provide special emphasis and would speed up the efforts of the states. Importantly, the German National Review reports that this Act pre-empted many elements of the 2007 Floods Directive, establishing deadlines for the delineation of floodplains and the preparation of risk management plans. Yet despite these developments, even in Germany it is reported that the transfer of flood preparedness into codes and standards is in its infancy.

Another apparent effort to address fragmentation at the sub-national if not national tier of governance is to construct partnerships that can co-ordinate action and marshal efforts in a common trajectory. This will also potentially facilitate the building of consensus and shared understanding across institutional silos. Such partnerships are proposed to be particularly efficacious in confronting problems such as flooding. Critically, however, although these can be powerful forces for change, pooling resources and gaining ‘buy-in’ and legitimacy from a multitude of actors and stakeholders, successful partnerships are notoriously difficult to first *create*, and secondly *sustain*. There are significant and well-documented strategic and practical challenges, not least in terms of the capacity-building of partners.

The previous section emphasised that there are significant problems when integrating *between* states at the EU level. Yet this situation is compounded by a lack of clarity about process and procedures even *within* many countries. Despite rhetorical promises and recent governance innovations, there is also a lack of partnership working within nation states, partly due to the immaturity of the concept of FRe, but also in light of inherited difficulties from administrative and managerial circumstances. It is challenging, therefore, for manufacturers familiar with one set of administrative arrangements to integrate or market a product across the EU. Members of the UK’s NSG, for instance, reported that the complexity of flood management and of governance below the nation-state inhibited efforts to market products in different countries.

4.2.2 The ‘roll-out’ of responsibility from Central Governments

A common trend observable across Europe in terms of national governance, and further contributing to the fragmentation noted above, is how responsibility for flood risk management and the integration of flood resilient tools, technologies and systems, has been rolled-out from ‘the centre’ – that is, from the nation-state. This can be seen as one aspect of a more general ‘hollowing out of the state’, with more responsibilities for traditional state functions placed on partnerships and networks of state and non-state actors (Rhodes 2001; Sabatier and Jenkins-Smith 1999). The nation-state can no longer be considered the sole dominant stakeholder in flood risk management. Criticised in many quarters as an abdication of responsibility to manage risk on the part of nation-

states, this retreat creates opportunities for (or under more critical assessments perhaps forces) many other actors both ‘beyond’ and ‘below’ the nation-state to take action to implement FRe.

The roll-out of statutory responsibility has been predicted to increase over the coming years as, in response to the global economic down-turn and associated attempts to reduce budget deficits, most European countries will reduce public sector funds (UK National Review and UK NSG). Demonstrating this, in the UK the structures of regional Government are being gradually dismantled, supposedly at the promotion of ‘localism’. In short, statutory bodies have fewer resources combined with a decreasing desire to take responsibility for flood protection. Not only will this mean a contraction of funding for the development and implementation of FRe where it is already of limited availability, but it will also undermine any prospect that statutory organisations will provide such resources for FRe in the near future. This situation is critical as, paradoxically, in many countries there is a perception on the part of citizens that protection from flooding is, and should always be, a primary responsibility of the state (a common theme across the National Reviews and one that is turned to in greater detail later). The German National Review stated that the public believe the State should provide flood defences and in the wake of a flooding event the payment of compensation for flood losses are an *obligation* of the Government. Yet concern was expressed that state intervention, particularly the view that the state should provide protection from flood risk, in fact serves as a disincentive for the uptake of FRe (Netherlands) – a theme returned to later. Demonstrating this, the German National Review stated that the federal Government’s *ad hoc* disaster relief in fact provides householders in flood risk areas a false sense of security and a disincentive for the private sector to enter the FRe market. It is also a disincentive for people to buy insurance policies or implement other FRe measures. Similarly, there is concern that compensation schemes paid by the State through tax-payers’ revenue is inherently unfair for people not at risk of flooding or those who have protected themselves at their own cost. It is also a disincentive for people to buy insurance policies or implement other FRe measures (Spain National Review). Such unfairness could be ameliorated through tax reductions or reductions in the premium of insurance policies, although the complexity of such a scheme makes such an initiative unlikely.

The UK National Review also draws attention toward the problems of transferring responsibility between tiers of governance. Here efforts to encourage local authorities to fulfil this responsibility have been treated with reluctance. That said, several national Reviews report that, even against the context of administrative reform, the transposition of the Floods Directive and the broad if not entirely forceful harmonisation of flood risk management across the Union will go some way to counteract national divergence in this regard. Further, despite potentially undermining coherence in policy and leadership

regarding the uptake of FRe, the diffusion of responsibility is also viewed as a facilitator as the range of competent stakeholders expands.

This creates a context of complexity for the integration of flood resilient features into practice. The integration of FRe products must pay regard to national circumstances, a clear challenge given the scale of the small-medium enterprise nature of the FRe manufacturing sector. Initial analysis for the SMARTeST Project in Work Package 2 has revealed that many measures could operate effectively within varying countries, but as emphasised in the NSGs the private sector do not feel they know how this should be best pursued. This issue, which may be described as the fragmentation of the FRe road to market to *multiple* national markets, will be addressed in later SMARTeST research.

Despite EU policies of convergence, there are considerable national differences in approaches to flood risk and, therefore, the integration of flood resilient features into the built environment. By consequence, different countries have contrasting approaches both to flood management generally, but also with respect to the integration of flood resilient tools technologies and systems creating considerable frustrations for the pursuit of resilience. Beyond diversity within national contexts, there is great uncertainty regarding the trajectory of flood risk management.

Responsibility for flood risk management has been ‘rolled-out’ to other tiers of governance and cascaded through to other stakeholders. As a result, capacity and power to act has become both dispersed and less certain. This decentralisation - and similar forces - *both* facilitates and constrains the uptake of FRe. Despite introducing further complexity and governance congestion, the emergence of a series of organisations below the scale of the nation-state with increasing or potentially overlapping responsibilities for flood management may in fact provide greater institutional momentum for the promotion of FRe.

4.3 Integration below the nation-state

4.3.1 Local Authorities

Authorities at the local, municipal or city scale have an ability to influence FRe. They interpret national guidelines and regulations and make decisions concerning the use of land. It is also here that multiple stakeholders could play a role in affecting the use of FRe, from built environment professionals to the construction sector to insurers. These agents of influence are discussed in more depth in the next chapter.

As the source of great risk and insecurity for citizens throughout Europe, the issue of flooding has risen to become one of great concern for electorates and by extension for

political representatives. Political representatives often represent constituents that feel under threat, helping to lobby for funding and bureaucratic support for flood defences including FRe. Under certain circumstances local political representatives with spending power can direct money to help facilitate FRe integration, or can assist individuals and community groups apply for and manage resources that can be useful in achieving FRe integration. The Greek National Review has also noted how the political will – or lack thereof – will have a considerable impact upon the context for FRe technological development and for its implementation into society. In this way, political dynamics and political leadership may be critical catalysts for FRe uptake and in achieving resilience. Illustrating this point, the French National Review in particular noted the important driver that local political leadership may provide, describing how local Mayors – at the behest of the electorate - can promote mitigation of damage from flooding as a priority. That said, the same review also recognises that, in light of mayoral mandates lasting only six years, municipalities tend to prefer to protect cities against ten or 20-year floods, rather than say a 100-year flood. In France in some areas the public have demanded flood protection; for instance in Fresnes in the Bievre catchment, with the existence of a NGO group consisting of victims of floods. The Cypriot National Review also reminds that given restricted resources, any public funds set aside for flood resilience will be subjected to competitive bidding.

Yet it is critical to note that, as with any political context, flooding is just one pressing issue of many. Moreover, despite being a critical force behind FRe integration, political drivers and electoral opinion may in fact serve as a *barrier* to implementation. The French National Review details how protection against flooding in a given area may in fact provide an unpopular reminder that a place is at risk. This may in turn have important implications for property values – driving them down in most cases. As such, there may in fact be political resistance to acknowledge that an area is at risk (Douglas *et al,* 2010). Moreover, when acknowledged to be at risk people may lobby for flood mitigation or for barriers to defend from inundation as opposed to measures that will be smaller-scale in nature or that may allow water into a property with a view to aiding recovery. Understanding political perceptions and reluctance to efforts to managing flood risk are critical, particularly given the impact that intervention on one part of the system can have on citizens living downstream or elsewhere in a system. If FRe technologies, systems and tools ultimately displace water, this will create further uncertainty and is likely to be less acceptable to a potentially sceptical public and political class.

But in other circumstances FRe may have political and administrative *support* given how it opens possibilities for development to progress in hitherto restricted places. In 1995 France's Barnier Law strengthened environmental protection through the development of the Natural Risk Prevention Plan (PPRN) which forbade settlement in the most dangerous areas, but this risk based approach can help regulate construction in flood-

prone areas where building is permitted. Given the restrictions that any such regulations bring, such zoning itself stimulates significant local conflict and debate. In Spain the greatest public skepticism is caused by the legal restrictions to land uses that have been generated by the enforcement of flood risk criteria in developing planning regulations. It has been argued that the integration of FRe may help make such zoning both more palatable, and may help threatened areas become commercially exploitable. In this sense, then, FRe may help facilitate other aspects of the planning process and can be a useful factor in mobilising support for development in many circumstances.

In addition to their more traditional role, in some countries contiguous administrations are establishing collaborative arrangements, both formally and informally, to pool resources to counteract flooding, and in limited instances to develop strategies for the integration of FRe into areas deemed to be at risk. Some Municipalities are forming partnerships to meet future demands. A prime example is the *Information and Advise Centre for Flood Resilience* formed in Rhineland Pfalz in 2010, constituting a voluntary alliance of municipalities to coordinate flood warning and emergency efforts, interpretation of flood risk maps, public awareness campaigns, as well as risk reduction practices through providing insurance and the creation of financial reserves. Similar alliances are being formed in other regions, such as the communal flood risk partnership of Baden-Würtenberg[3]. In the UK Regional Flood Committees may agree a local levy (often against local authorities) to pay for works that do not warrant national funding. In France too regional and county authorities have both become a source of information regarding FRe options, and in the provision of incentives and facilitation for their uptake.

Under their most stringent application, across Europe rules regarding construction in flood prone areas can ‘red-line’ or ‘lock out’ vast swathes of land from development. Several National Reviews (particularly France, Germany, the Netherlands and the UK) reported that their Governments, often at the behest of powerful economic forces, are currently pursuing efforts to liberalise the spatial planning system, relaxing restrictions on gaining planning permission, and releasing previously undeveloped land for construction. Ironically, though, permission to build on land prone to flooding itself will also provide a stimulus to the application of FRe (see the France National Review).

4.3.2 Community and individual responsibility for integrating FRe

The actions of statutory actors and the private sector have a considerable influence upon the facilitation or hindrance of the integration of flood resilient tools, technologies and systems. The state establishes the context for integration – by establishing regulatory regimes, by issuing directives on construction and planning criteria, or by providing

[3] Deutscher Städte- und Gemeindebund (DStGB) Vorbeugender Hochwasserschutz – eine Querschnittsaufgabe von Bund, Ländern und Gemeinden. 2010.

support and capacity for FRe implementation. Equally, as will be discussed in the next chapter, agencies such as manufacturers and insurers also have an important role to play in achieving FRe integration, through their activities in promoting the market for FRe and by capitalising upon opportunities for FRe innovation.

A further potentially even more critical sector that has a considerable impact upon FRe integration is broadly referred to as 'the public' (communities, individuals and also civil society organisations such as non-governmental organisations and pressure groups). Not only has the public assumed greater *responsibility* for governing, often as the central state has seemingly 'retreated', but as the principal users, benefactors or funders of FRe, there is a growing perception that people possess a fundamental *right* to protect themselves from the risk of flood. In many quarters, it is accepted that the public - particularly those at direct risk of flood - could be *the* most critical stakeholder in facilitating or hindering integration, not least as those with prime responsibility for their commissioning, maintenance and deployment.

This section, again drawing upon insights from across the National Reviews and NSGs, reflects upon the significance that this tier of action and implementation has upon the challenge of integration.

4.3.3 Increased responsibility for communities and individuals

There little doubt that recently the public have inherited ever greater responsibility for flood risk management in all countries across Europe. Not only is the state less able (and some would say, less willing) to provide protection, but there is a recognition that those at risk may well be best placed to manage that risk in the most effective and responsible manner.

The drivers for this change have emerged both from the 'top-down' as statutory actors and administrators have instigated initiatives to engage individuals and communities in public administration and in flood management, but also from the 'bottom-up', as people have asserted claims for self-governance and their willingness to assume responsibilities for flood risk management. Given the aforementioned retreat in the role of the state in this regard, and constraints in public finances across most European countries, this desire for better vertical integration is likely only to gain momentum in the medium-term future.

That said, a clear exception to this momentum is in the Netherlands where, given the unique geographical and hydrological circumstances of this country, protection from flood has relied almost entirely upon state provision of structural flood defences. The Netherlands National Review highlights how the state-provision of large-scale flood protection leaves little scope or need for smaller-scale FRe uptake. However, homeowners *also* have the responsibility to ensure their house structure is watertight to

prevent groundwater intrusion and possess primary responsibility to collect rainwater that falls on their property. Demonstrating this, under the new *National Water Law*, homeowners are specifically expected to manage pluvial waters on their property. However, if they can show that they are unable to apply stormwater storage and infiltration, e.g. if there is limited space on the property to do so, this responsibility then falls to the local or municipal government. The new responsibility for home owners for stormwater storage is likely to trigger the increased uptake of rainwater harvesting and stormwater storage and infiltration facilities.

In some countries homeowner and citizen protection from flood risk is enshrined in law as a definitive responsibility of those at risk, offering an important potential driver in FRe uptake. Similarly, in Germany Article 1a, Sec.2 of the Water Resources Act of 2005 requires that every person likely to be affected by a flood should take all necessary precautions to avoid or reduce losses. This provision is legally binding and violations may result in penalties, providing a further incentive for FRe uptake. However, according to the Netherlands National Review and to a lesser degree the German National Review, even with this legal provision it is challenging to precisely identify whether and how this will influence the uptake of flood protection technology. Despite legislation in Germany where improper construction leading to outright collapse can lead to owners being held liable, decisions regarding flood-proofing lie with the property owner.[4] And, as will be detailed later, it is unclear as to how vigorously enforced such regulations are and how familiar those deemed responsible by law are with their new obligations.

Several National Reviews also reported that citizens often, for a variety of reasons, expect the state to protect them from flooding. This expectation, based upon experience and attitude, has important implications for how flood management is conducted, and for how flood resilience can be integrated. Several National Reviews and many of the NSGs reflected upon the significance of this, in the vast majority of cases proposing that this would create a major barrier to FRe integration. This point is developed in the following section.

4.3.4 Public perceptions of state responsibilities

Traditionally flood risk management has tended to depend upon state-sponsored defences, often structural and hard-engineering in nature. However, as reported by all the National Reviews, the public have an overwhelming perception that not only should *large-scale defences* be constructed to protect places at flood risk, but that this should be almost the sole *provision of the state and of tax-payers*. Indeed, several National Reviews argue that the strong role of government in this regard limits the interests of individual

[4] Bundesministerium für Verkehr, Bau und Wohnungswesen: Planen und Bauen von Gebäuden in hochwassergefährdeten Gebieten – Hochwasserschutzfibel, 2002

home owners (citizens) in applying flood protection measures. Simultaneously, many property owners have yet to be convinced of the efficacy and benefits of FRe measures. In contrast, the Living with Water agenda requires a paradigmatic shift in public attitudes to floods and as such represents a deeply embedded cultural and psychological barrier. This theme is returned to in further detail in the following section.

The assertion that the public expect protection to be afforded by the state, and that this should consist of large scale structural defences that reduce the chance of flooding, was reiterated by the French National review which detailed how, even after the breach of dykes in recent floods, local people expected dykes to be repaired, wanted compensation from insurance to repair flood damage, and ultimately to live as they did before the flood. Recently new constructions were accepted in areas which were flooded after Xynthia (such as in La Faute-sur-mer in the department of Vendée). Similarly, the Greek National Review notes that the public response is usually to return to one's residence and protect their property while even in cases where that does not apply as the safest result. Again, this intransigence on the part of the public and their deeply held beliefs that the state must protect from floods - though understandable – provides a deep challenge to efforts to shift responsibility away from the state.

The Netherlands National Review details how, for the most part, the authorities still favour heavy engineering solutions. In a more critical fashion, the Review also notes that the promotion of FRe may in fact undermine efforts to develop more effective and more durable long-term solutions to flooding problems. The Review's authors reflect upon this by stating: "*Public resistance in the Netherlands may have something to do with the fact that our government is the primary stakeholder in developing and executing flood management policies*." By consequence, it could be argued that people tend to think that only the government is responsible for their safety and they are reluctant to invest in FRe technology if they do not feel responsible for their own safety.

The National Review for Germany similarly attests that most of the general public remains convinced that flood defence and compensation for flood losses are an obligation of Government. After the floods of the Rivers Elbe and Oder, which caused €9.2 Billion damage, the German Chancellor made a promise that "*no one should be left worse off after the flood".* Yet the German National Review notes that the "*compensation paid led public to believe that flood damage compensation and flood defence are a government responsibility*". This is the case, even though Art. 1a, sec.2 of the 2005 Water Resources Act obligates private persons to use FRe practices to avoid flood losses. Similarly, in recent Cypriot floods, victims that have not received assistance from insurers have in fact been compensated by the Government. There is, therefore, a reluctance to pay for property or small scale flood resilience by many. There is, the same Review continues, a need for FRe to be subsidised, at least in the short term.

Attitudes and actions of decision-makers and power-holders have helped further ingrain this perception and perhaps too the view that the state should assume a paternalistic approach to citizens. For example, the French National Review states that in many instances, citizens are not consulted regarding risk prevention. The Review continues that there is a lack of balance between collective solutions to flooding developed by the water and sanitation service and solutions developed by individuals. This is mainly due to a lack of communication between decision makers, administrators and individuals.

To summarise, there is a common perception that not only flood defences, but remediation after the devastation of a flood should be provided by the state. The provision of compensation by the state – well meaning and so often absolutely necessary for people to recover from the impacts of a flood event – can be counter-productive to efforts to encourage the public to manage the flood threat themselves. Safe in the knowledge and often comforted by promises from politicians that statutory organisations will assist flood recovery, people at risk are disincentivised from using FRe. Moreover, the state tends to dominate decision-making procedures, undermining the over-arching effort to promote individuals and communities in assuming responsibility for integrating efforts to manage flood risk.

4.3.5 NGOs and civil society

Civil society organisations, such as national or local non-governmental organisations, can emerge as critically important actors in facilitating and supporting the integration of FRe. They might, for instance, act as advocacy organisations, promoting the issue of flood protection or representing flood victims or communities at risk in much the same way that political and administrative leaders are able to. This can occur at various spatial scales – specific areas threatened by flood, or perhaps to represent victims on a national level. Turning to the implementation of FRe, it is also now widely recognised that communities that bind together can pull resources and efforts in order to develop resilience over a wider area.

For example, the French National Review describes how ‘public associations’ and non-governmental organisations (NGOs) can be a potentially powerful force in raising the issue and impacts of flooding with political leaders, civil servants and stakeholders. Some NGOs, the Review continues, can provide advocacy for flood threatened inhabitants, or can represent the interests of local people. Yet the Review also recognises that in other circumstances some NGOs can radically oppose development (occasionally on the basis that flood risk will be created or increased), even if it plans to integrate FRe.

The German National Review further mentioned how NGOs are a primary political driver, holding the state ‘to account’, challenging decisions to fund or withdraw support for flood

protection. Examples of such NGO work are the State Work Association Water (LAWA)[5], and the German Association for Water-management, Wastewater and Refuse (DWA)[6], although there are also many others. The Review continues: *"The EU Floods Directive is generally seen as an opportunity for betterment and many NGOs that are also professional associations have a long history of setting up working groups that issue technical papers and practical guidelines for the implementation of new concepts."* Notably, therefore, the Review asserts that trade associations have a critical role to play in opening the market for FRe. However, caution must be demonstrated given the fact that many such organisations may possess commercial interest in the promotion of FRe. More practically, care must be taken to ensure trust and confidence in advocates is not undermined.

The Greece National Review has reported that local government intervention has increased since local communities established relevant citizen bodies which allow the active participation of citizens. Such bodies progress appropriate measures for flood proofing by conducting studies and in certain cases implementing necessary projects. Yet, the approval for the aforementioned activities either arrives too late or not at all and the best way to promote such activities and citizens initiatives is to provide with timely decisions.

Stakeholder involvement for successful FRe integration must extend beyond citizens and communities. In some circumstances, successful FRe integration requires the co-operation of land-owners or land managers particularly where flood prone areas have multiple uses. The French National Review cites a necessity to involve the farmers in the development of such areas. It has recommended 'learning coalitions of stakeholders' are formed to facilitate the implementation of flood risk management planning, placing the planner into the role of mediator, gaining public confidence and winning consensus among stakeholders. The German Review reinforces this view stating that it is only through such awareness (including education) and participation that citizens 'will support flood resilience planning projects', and understand that they may need to take their own flood prevention measures and learn how to act during flood events. This view is also highlighted in the following chapter on horizontal integration.

4.3.6 Financial implications

Across the majority of the National Reviews, the financial implications of flood resilience tools, technologies and systems - both positive and negative and both direct and indirect - have been identified as a critical factor in understanding integration for communities and

[5] Länderarbeitsgemeinschaft Wasser (LAWA) "Hochwassergefahr, Vorbeugen, Schäden vermeiden", Berlin 1996

[6] DWA-M 551 (2010) Merkblatt Audit "Hochwasser – wie gut sind wir vorbereitet" Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e.V. DWA , Dec. 1010

individuals. The same theme recurred in the proceedings of the NSGs and was raised regularly during meetings with manufacturers and innovators, particularly in light of the current economic climate (Greece National Review). Much of the debate regarding this pertains to rather obvious questions of who should fund FRe. More particularly, it is queried, should those ultimately benefitting from FRe implementation assume the greatest burden for paying for that protection? Consideration must also be paid to the life-cycle costs of any FRe feature – from the cost of the initial survey of risk exposure and installation requirements, through the procurement of features and their maintenance, to the repair and re-configuration of FRe after a flood event. The issue of maintenance is perhaps even more important in instances where FRe is provided for a property or building by a third party.

Initial outlays for installation and ongoing maintenance obligations can prove prohibitive for many properties across Europe and a disincentive for FRe integration. The costs for the effective integration of FRe may prove expensive across various elements of society. Most acutely, FRe protection may be entirely elusive to poorer communities who ironically are least able to cope with the financial implications and inconvenience of floods in the first place and there may be social justice implications associated with operationalising the Living with Water agenda

Mirroring previous sections, there is too a frequent public perception - even amongst householders and business owners with responsibilities for not inconsiderable assets - that protection should be paid for by the state or even by insurers. The German National Review specifically asserts that there is public interest in using FRe features, yet only if the Government pays for it. There is, the Review affirms objections to self-protection on the part of property owners. Moreover, this belief extends that true protection will be provided not by FRe but wider scale flood defence programmes that may afford flood alleviation to wide communities and regions.

There are also other financial implications that may both support or undermine the integration of flood resilience at the individual, property and community level. In most parts of Europe, housing is more than a place to live: it is a usually an individual's most important financial asset. Despite a desire to defend their homes and investments, the protection provided by FRe is notoriously difficult to quantify and has a limited (or at least unclear) ability to add value to property prices. At worst, FRe may even *detract* from property values. For instance, several National Reviews outline that the fitting of flood protection, or the very acknowledgement that an area or property is at risk of flood, is not only a potential acceptance of liability but it may make a property or even entire area unattractive for purchasers (Douglas *et al,* 2010). This might in extreme circumstances have a detrimental effect upon house prices. For similar reasons, the Project team were told by several stakeholders in the UK that homeowners may be unwilling to report

flooding, or reticent to embed protection for fear of devaluing their property. Given this status, some FRe manufacturers have stated that in order to be acceptable, FRe features should not be recorded on official records (for instance in the deeds of a house) and preferably should not be overtly visible. However, questions should be raised regarding the honesty of this approach, and whether 'hidden' FRe contributes or detracts from efforts to normalise and institutionalise the Living with Water agenda. This may also detrimentally affect their ability to ensure the product is well maintained, particularly as the owners of property change over time.

Although much of this section has contemplated the at times formidable barrier that funding and financial implications may have upon FRe integration, gaining support can greatly assist FRe uptake. In France, private individuals and homeowners who wish to place barriers to protect their house (or, for that matter, a local authority who want to make an information campaign) can apply to the State's risk prevention fund, offering a further potential opportunity for FRe uptake.

Quite obviously the financial implications of FRe implementation will be a critical element of people's decision-making calculations (and that of other stakeholders and administrative decision makers too). Although where technologically effective, properly installed, appropriately used, and adequately maintained, FRe undoubtedly lends protection to a property, many actors and stakeholders are not currently fully convinced of the attributes of FRe. These important themes are related to the section of the report that considers the broader challenges to acceptance of the Living with Water agenda, many of which are derived from deep psychological concerns regarding risk and its management. The financial circumstances of FRe integration will of course be a significant barrier for low-income communities, people with few savings, and also those in rented accommodation who are not themselves property owners and therefore unable to install FRe in the homes they inhabit. Yet beyond concerns regarding the *ability* to pay for FRe, regard must be turned to the *willingness* to pay for FRe: people must be convinced of the effectiveness of flood resilience features, and must accept the premise of FRe both as a concept and as a practice.

4.3.7 Public information and capacity to engage with integration

Despite being promoted to be at the forefront of many efforts to implement flood resilience features, and the critical role that they have in securing integration, it is asserted that against a context of uncertainty the public often lack a) the information and knowledge and b) the capacity to fully engage with efforts to promote Living with Water. All the National Reviews and other forms of research conducted as part of the Project highlighted this as a significant challenge to integration, and as offering great potential to overcome many challenges to implementation.

In France, some guides or documents are designed and diffused by the municipalities. From a legal point of view, the general public is informed of risk through the “local main risk information document” (*Document d’information communal sur les risques majeurs*). For the 100th anniversary of the “1910’s flood” in Paris, several meetings and exhibits were organized by the Environment and Energy Regional Direction and local authorities. Flood atlases are also developed to help inform the general public about flood risk. Targeting information to the owners and tenants of dwellings (“Information Acquéreurs Locataires”, also called “IAL”) is a good means to inform the general public. In the case of a sale or a renting out, the buyer or the tenant is informed of the natural hazards concerning their dwelling. However, tenants are only informed that there is a risk, unlike buyers who must be given by the vendor a map specifying the level of risk. Similarly in France, when composing risk prevention plans, there are public inquiries to inform the communities of that risk and neighbourhood meetings are organised and flyers distributed. The Spanish National Review welcomes the prospect that the mapping of risk is a requirement of the Flood Directive, meaning risk can no longer be concealed to prospective buyers. Meanwhile, in Germany the increasing public awareness of risks takes the form of emergency plans, holding exercises and drills creating information chains, distributing booklets, information plates and flood markers at prominent places.

The Greece National Review cites previous flooding as a significant contributing factor to citizen awareness of risk. A view supported by the German National Review, which stated that 59% of the households affected by the River Elbe Flood of 2002 previously did not know they lived in a flood prone area (Kreibich *et al*, 2005). People living in these affected areas may form local bodies (usually partnerships between statutory organizations and citizens and other actors) to promote flood awareness and initiatives to create safer environments. As noted in the French National Review, actual flood events revive the debate about the creation of a national public fund to assist victims after a disaster. There are, therefore, deep challenges to the countering of flood risk in instances where flood risk does not have such immediacy, or when flooding has not occurred recently. The memory and experience of flooding is, therefore, critical in helping citizens understand risk and what to do in the event of a flood.

It has been suggested that higher quality mapping and the more accurate identification of how any given flood will impact an area and those that inhabit it (as is aspired to by the EU Floods Directive) will support the uptake of FRe. If risk is acknowledged there is a greater chance that risk will be accepted and that momentum will gather for FRe integration. This is an issue explored in more depth in the following chapter.

Although there has been progress in acknowledging the wide ranges of risk that society faces, across many European countries there is currently limited guidance available concerning flood resilient materials or flood resilient building design. The resilience

improvement sections of the French Flood prevention plans contain wording such as to "replace the existing materials with less water sensitive materials". However, there is no list of such products or even technical specifications. This precipitates further challenges for community decision-making and for empowering local people to manage risk for themselves. It may be here that the findings in Work Package 2 can also play a role.

The French National Review has also critiqued the information provided to citizens (and other actors for that matter). Referring to work by Marchand and Salagnac (2009), the Review identifies the following explanations for this situation:

- their unfamiliarity with local contexts;
- they are too complex, too technical, too long
- they are not conceived according to targets
- they do not correspond to a national policy with objectives, incentive financing, etc.

There is a distinction to be drawn, however, between information accumulation and the capacity of the public to engage with decision-making processes. The German National Review identifies a need for increased "risk communications" at the community level, helping to bring about *more* public participation in planning. There can be no meaningful stakeholder participation effort unless there is a knowledgeable and aware set of participant (Tippett and Griffiths 2007). This may also help address the data-rich information-poor syndrome (de Pauw 1996) outline previously. In Greece significant efforts have been placed into informing citizens and agencies of the implications of development through information events and advertising campaigns. This is critical, the Review's authors state, particularly if efforts to localize and lead decision-support systems regarding flood management are to come to fruition.

As discussed in more detail in the next chapter, although there have been significant advances in flood risk mapping and modeling, and in informing local people of this flood risk and action to take in the event of a flood, serious problems with these efforts have been identified. Flood maps are often of high scales, losing effectiveness through a compromised detail. Where mapping and information is of high quality, people are often no more knowledgeable of what action to take to off-set risk. According to innovators in NSGs in the UK and Greece, one of the main challenges is 'access to the market'. Few people at risk understand its implications and fail to understand that they can use FRe to help counter risk in some way.

Given the citizens' promoted responsibilities in integrating FRe and in helping manage flood management more generally, public information, knowledge and capacity is a fundamental component of FRe integration. Yet modern technology provides unparalleled opportunities for information and communication and there are significant opportunities

for stakeholder participation. One solution could be to supply better information to the public and other stakeholders, for example, by computer assisted planning and education aids targeted at the needs of different stakeholder groups (Tourbier and Ashley 2007). Plan formulation, the Germany National Review continues, is a learning process for participants that can be assisted through learning tools (Tippett and Griffiths 2007).

4.3.8 Participation in governance

It is acknowledged that the effective management of flood risk requires the involvement of a wide range of stakeholders; that is those impacted by flood and those able to take action to affect how flooding occurs. The public have emerged as critical, though not the only, stakeholders in this regard.

As has been suggested by the German National Review, flood control has in the past been the almost privileged domain of civil engineers or a handful of political and administrative decision-makers. Today, though, it is acknowledged that this is a dated and ineffective approach representing a significant departure from previous practice. The EU Floods Directive requires an interdisciplinary approach to flood management. Turning to specifically consider the Directive's implementation, the Spanish National Review reports that the enhancement of public involvement in planning for the potential of floods presents a 'new challenge' for traditional forms of administration. The Review asserts that the enhancement of civic awareness regarding natural risks is essential for this change. A critical element of this, the review adds, entails the 'proper preparation' of the public to engage in administration – in other words 'capacity building'. Similarly the French National Review reports that in light of administrative re-organisation after the transposition of the EU Floods Directive all actors and stakeholders must be empowered in order to manage and prevent flood risk. This is, the Review continues, critical given the centralised nature of the French state; it is widely acknowledged there should be greater effort to involve local people in creating resilient places.

Despite the admirable intentions of participatory governance, and the widely lauded attributes it brings to governance processes, participation is not without critique. This relates both to the practice of participation, and the sincerity brought to participation processes by fellow actors and stakeholders, particularly the state. The French National Review details how the SDAGE (River District Plan that conforms to the Water Framework Directive) implored water agencies to merely *inform* rather than *encourage genuine participation*. Moreover, the French National Review states: "It's difficult to say that the management plan of flood risk developed by the Flood Directive will lead to participative procedures." It is acknowledged, for example, that efforts to gain participation may need to contend with a degree of public apathy not least because there is a common perception throughout the public that flood protection is a prime responsibility of the state and local government. Even though every planning project in

France must have scope for public comment and involvement, “there is almost no participant in 99% of these public enquiries”. The National Review for the Netherlands draws attention to how the involvement of a multiplicity of actors may introduce a lack of clarity to decision-making. These observations resonate with well documented critiques of public participation initiatives that have cited consultation congestion, consultation fatigue and even consultation apathy as being common reasons for non-participation in decision-making processes (Cleaver 2001; Taylor 2000).

The German National Review draws attention to how the legacy of participation and non-participation can have serious impacts upon public engagement in decision-making and flood management. As the Review states: “*stakeholder participation is ‘still a novelty’ in both the formerly Communist states of the Republic and [parts of] the old democratic Western Germany*.” Even when an integral element of the decision-making process, the review further states that participation creates many further practical challenges: *“It causes extra costs, makes the planning outcome uncertain and causes delays in time. It will remain a planning frontier for some time to come, though few would admit it”*. Concerns were also raised about the bottom-up approach for the involvement of stakeholders in a planning process where the result is open and where some stakeholders will pursue vested interests. With this in mind attention must be paid to the impact – both positive and negative – that participation may have upon integration.

The French National Review states that most decisions are derived from the central State. Whilst innovations and initiatives to reduce the vulnerability of cities or neighbourhoods are developed by local stakeholders, they are not always recognized and encouraged by the state. The Review co-authors have observed in Languedoc-Roussillon that this creates resentment and hinders the local dynamic to reduce vulnerability (Marchand and Salagnac 2009).

In a 2009 German survey conducted with state, regional and local agencies,[7] concerns were raised about the bottom-up approach, especially for the involvement of stakeholders in a planning process where the outcome is unclear. There is a further concern that some stakeholders, who may not even be the most affected by decision-making, may pursue vested interests and that blockages may accumulate in decision-making deliberations. That said, the German National Review asserts that to successfully deal with the complexities of adaptive systems - and to simultaneously meet the requirements of the Water Framework Directive - an interdisciplinary planning approach is necessary. Stakeholder involvement is supported, the Review suggests, by ‘special integrative teaching and learning modules to build capacity in all stakeholders’. This must be underpinned by transparency and communication to be practiced by units of government.

[7] http://www.hkc-koeln.de/de/projekte/projekt-3/hw-managementrichtlinie/index.html

It is acknowledged, therefore, that significant support is required for people to be able to take informed and effective decisions, and perhaps most critically to understand their contexts. EU Directives seek stakeholder identification and participation as a component of the planning process, not to be treated as “after the fact” participation review of completed. Rather, stakeholders should be involved from the outset of any planning process, starting with the definition of goals and objectives up to the formulation of a plan and post project evaluation of outcomes (German National Review). The combined implementation of the Water Framework Directive and Floods Directive is a new experience for all the parties involved. There will be a need to develop integrative teaching and learning modules for site planning and implementation and planners will increasingly need to communicate ideas through a learning process, leading to recognition of risks and risk reduction, gaining public confidence and winning consensus among stakeholders (Tourbier and Ashley 2007).

Despite the promotion of public involvement in policy public administration, concern has been expressed regarding the sincerity, the extent and the efficacy of community and public participation. Citizens are accustomed to flood control being the responsibility of government agencies acting primarily on technical arguments. Yet not only do new EU Directives require attention to be paid to a wide range of public concerns, but flood risk assessment and management planning will further bring together a wide range of professional groups, each with their own agenda. This is discussed in more depth in the following chapter on horizontal integration.

4.4 Conclusion

Despite the great influence exerted by the EU, nation state and local level governance, the views of other stakeholders involved in FRe, such as the general public, are of significant importance. Throughout the National Reviews and NSGs and across the research conducted in completion of this report the perceptions of the public of FRe usage and of Living with Water emerged as critically important for securing integration. This is challenging both in concept and practice. The French National Review (drawing upon discussions at the France NSG) identifies this significant barrier as being related to the ‘normalising’ of FRe. In particular, public reticence to the aesthetics of FRe features has been identified as a further potential barrier to integration. It may be difficult for instance, to encourage local people to have a risk assessment conducted on their property and then to persuade people that FRe may be beneficial. As this chapter shows however, this normalising extends beyond the public to all those concerned with vertical integration.

5. HORIZONTAL INTEGRATION

As outlined earlier, the move from flood defence to flood risk management, allied with recent EU and national level policy initiatives, highlights the need for better integration of FRe into practice. Whilst the previous section explored issues surrounding *Vertical* integration; attention is now turned to *Horizontal* integration, which refers to the widening of engagement to all those stakeholders who can play a role in enabling the use of FRe. As suggested by Tourbier and Ashley (2007) flood risk assessment and management planning today impacts upon a wide range of professional groups: civil engineers, city planners, architects, landscape architects, economists, social and behavioural scientists, public health specialists, commercial interests, lawyers and other professional organizations, and resident- and interest groups organized in NGO's. Although this creates many opportunities for FRe integration, as the section will demonstrate, engaging with a wide array of stakeholders also brings challenges and problems.

Despite the recent widespread use of terms such as risk or resilience, it is impossible to assume there is consensus on their definition and usage. The terms are often deployed liberally and they often lack clarity, to the extent that their use has been compared to the wide and varied interpretations of the term 'sustainability' (White 2010; Wisner *et al*. 2004). The term sustainability itself has been utilized in unforeseen and often contradictory ways. Indeed some observers suggest that this lack of specificity may have contributed to the growing popularity of terms such as 'resilience' in the social sciences (Klein *et al*. 2004). In disciplines such as economics and sociology, notions of risk have been considered since the mid-twentieth century, yet accord on its precise definition has still been difficult to achieve. For example, in a 1992 Royal Society report there was disagreement between social scientists and physical scientists as to the nature and meaning of risk (Adams 1995). Douglas (1992: 58) also highlighted how separate professions may interpret risk differently within decision making, arguing that:

> *When faced with estimating probability and credibility, they come already primed with culturally learned assumptions and weightings…they have set up their institutions as decision processors, which shut out some options and put others in favourable light*.

Given the definitional contention highlighted in the literature analysis amongst and between professions, the understanding and effective application of FRe must be analysed in more detail. This section will firstly highlight how perceptions of risks may differ amongst and between sectors before exploring views within each of the main stakeholders groups in more depth.

This review explores vertical integration, starting with a discussion of the over-arching themes:

- Perceptions of Risk and Resilience
- Modelling and mapping

It then goes on to look in more detail at key sectors synthesising data from the National Reviews, namely:

- Built Environment Professionals
- The Construction Sector
- Insurance Sector
- FRe Sector

5.1 Perceptions of Risk and Resilience

Throughout the 20th Century the framing of risk was dominated by scientific statistical and quantitative analysis, often in line with advances in mathematics, probability, computational ability, modelling and mapping. The understanding of risk has also been heavily influenced by the insurance and legal industries which used statistical expertise and knowledge of probability to prescribe compensation for future undesirable events. As it can greatly influence the 'road to market' of FRe, it is important to consider issues connected with the perception of risk and resilience by differing stakeholders and the way that these concepts may be understood. For example, the construction and interpretation of data by scientists is subjective and different professions and agencies may interpret information in various ways. Moreover, citizens to whom this risk is subsequently communicated may be risk averse, or alternatively may be willing to accept different levels of hazard, making the perception of risk an influential factor.

Despite advances in modelling and data, it is worth noting that risk is not a 'real' phenomenon as such and therefore cannot actually be measured. In actuality there are no 'risks', only perceived perils. Moreover, the temporal nature of risk as a *future* hazard means that it can never be 'experienced'. Therefore the concept should be viewed as a socially constructed danger that disappears as soon as an event occurs, at which point it transforms from a risk into an 'impact'. So risk is stochastic, but perhaps a result of increased apparent precision in our understanding of risk from the statistical, engineering and physical sciences, risk is incongruously widely seen to be both actual *and* incalculable.

At the same time, the knowledge generated can be considered fractal, revealing ignorance as new gaps in understanding become more apparent. Perhaps incongruously, therefore, risk may become more uncertain as knowledge increases. This highlights the difficulty in assigning clear values to complex and sometimes relative issues, and also how true risk resists accurate measurement. As Adams (1995: 29) asserts: '*risk is constantly in motion*'. The complexity in calculating objective values for indeterminate risks requires recognition of uncertainty as a critical concept in itself. This situation inevitably presents deep-seated communication challenges.

Increased understanding of the failure of attempts to manage complex systems have led to the concept of 'irreducible uncertainty', suggesting that uncertainty about the behaviours of systems is not merely a factor of a lack of data and information, but is inherent in any complex system. It is not that we simply do not know enough to be able to predict future impacts and change, but we cannot predict outcomes in complex systems with certainty (Funtowicz and Ravetz 1994; Ravetz 1997; Ravetz 2011).

There are further concerns, not least how decision-making can consider the unknown. This has been attempted, for example, by the creation of climate change scenarios; increasing knowledge or incorporating integral resilience, such as can be provided by FRe. Therefore, with regard to FRe, the very communication of uncertainty regarding data could in fact be viewed as a positive development as it bolsters acceptance of the need for integral resilience and our ability to respond to unclear, dynamic situations.

The acknowledgment that risk is connected to perceptions and constrained by incomplete information in turn forms the basis of the more contemporary standpoint that risk is socially and culturally constructed. Beck (1992: 99) argues that risk has become shaped by the application of statistics and the expansion of the insurance industry and referred to:

> *...systematically caused, statistically describable and, in this sense, 'predictable' types of events, which can therefore also be subjected to supra-individual and political rules of recognition, compensation and avoidance*.

Therefore, the way risk is interpreted shapes our responses – understanding this concept is key to the implementation of FRe. In reality, risks from flooding are socially constructed and the ability to manage them is influenced by how FRe is perceived. Similarly, given this social construction, the messages given about flood risk through policy interventions may not accurately reflect either its conceptual complexities or the ambiguity in its evaluation. The simplistic language of risk calculation may falsely reduce uncertainty to a comforting illusion of deterministic, probabilistic processes within which the inherent gravitas of scientific calculations can attach a misleading confidence to tentative

outcomes (White 2010). This was a point recognized by Wynne (2009: 308), who argued that the current methodology for managing risk is erroneous and: '*the dominant risk science approach is more than a method; it is a misbegotten culture which inadvertently but actively conceals that ignorance*'.

Given this context, it is inevitable that the way risk is subsequently perceived can also vary greatly between the lay person and professional and may not reflect the real chance of harm in a realistic manner. For example, the general public may believe that if a house is granted planning permission, or FRe measures are fitted, then it is safe from flooding. Yet the risk of flooding is not the only issue in planning or construction decisions, which consider other needs and may make an economic judgement on why people should *live with* a small risk of inundation. Nor does it recognise that the built environment is constantly under change, and that risks will change over time.

Stakeholders influencing FRe adoption within communities may have access to privileged information, and some might see them as neutral and in a position of trust, firstly in processing scientific risk data, and then in making decisions to ensure that the public is adequately protected. But risk is constructed differently by experts and citizens, and consequently amplified and communicated in a different ways by various actors and agencies. The perception of risks also differs between sectors, for example amphibious buildings are often mooted as a resilient solution. Whilst they may be promoted by some in the construction sector however, they may be viewed with suspicion by planners, who as some National Reviews note, tend to be generalists with limited expertise in the field of applied FRe (UK, Cyprus) and lacking the ability to consider risk comprehensively. The French National Review highlighted that although the promoters of such buildings claim they can build in areas where traditional buildings are forbidden, they have been banned on safety grounds and their authorisation has not yet been granted.

The process of weighing up risks and benefits is, however, rarely transparently conveyed. The general public implicitly believes that the planner will ensure that their newly constructed house will be *completely safe*, not only *partially* protected as there was a competing persuasive need to provide housing or because resilience measures had not passed certain testing protocols. In practice therefore, a citizen who may be naturally risk averse may be subject to a level of flood risk which is uncomfortable; again this may support arguments that communities and individuals should possess greater control over the use of FRe and greater access to information about risks. The shift in flood management away from the state has, however, challenged some accepted conventions. For example, the NSGs revealed that many citizens do not trust the FRe sector to provide impartial advice, hindering their ability to implement FRe solutions and thus protect people and property.

There also seems to be a lack of agreement between the potential of resilience in theory and academia, and its application in practice. For example, since 1982 in France (the date of the CAT-NAT compensation scheme), public policies have encouraged the evaluation of vulnerability. The question of the reduction of vulnerability has emerged with increasing frequency and some technicians in local communities do engage with the agenda. But in practice flood resilience appears to be an issue mentioned more by researchers than by elected or technical stakeholders (Marchand and Salagnac 2009). Equally, the German Review argued that many decision-makers received an education that concentrated on structural flood defence and view the concept of Living with Water sceptically. Concerns exist regarding the lack of knowledge and expertise of professionals such as planners and surveyors regarding FRe options and performance, as reflected across the National Reviews (Germany and the Netherlands in particular).

The Germany National Review stipulates that there also should be continuous teaching and learning opportunities on the professional level specifically aimed at urban flood risk management. The Best Practice Document (UN/ECE 2003)[8] points to a need for education and exchange of knowledge, stating that the integration of knowledge into graduate and post-graduate education programmes is essential. It further states that this should include Advanced Study Courses on topics related to flood management and "training for professional engineers, scientists, technologist, economists, ecologists" as well as professional bodies that require an annual programme of Continuing Professional Development as part of a registration. In Germany states now issue FRe technical advisory reports including flood-proofing and construction materials for developments on floodplains including matrices of measures to be used for new developments and for the retrofitting of existing developments[9]. Such best practice documents describe examples of flood risk management including flood-proofing steps that municipalities and homeowners could take. An example is the Ministry for Environment and Regional Planning of the State of Nordrhein-Westfalen issuing a manual on flood proofing

A major challenge, therefore, comes from how professionals, such as planners and civil engineers, are educated. There is a need to challenge deeply held cultural and institutional reluctance to change.

The communication of objective versus subjective risks is therefore vital, both between professions involved in the built environment and to the public. It was argued by some NSGs that more collaboration and partnership working between the state and trusted

[8] UN/ECE, "Best Practice Document "Best Practices on Flood Prevention, Protection and Mitigation" UN/ECE Athens, 2003

[9] Hochwasserfibel – Bauvorsorge in Hochwassergefährdeten Gebieten. Ministerium für Umwelt, Raumordnung und Landwirtschaft des Landes Nordrhein-Westfalen, 1999

NGOs, and the private sector could provide a solution. For example the German National Review argued that:

> *'there should be more knowledge exchanges through professional bodies and membership based societies, hosting meetings and conferences. In addition there is a need for increased "risk communications" at the community level, helping to bring about more public participation in planning.'*

A further barrier emerged from the UK NSG and various National Reviews, that there is a perceived lack of trust in the information given by the companies who stand to gain from implementation of FRe technologies. This involvement of trusted NGOs and membership bodies in the debate may therefore be a key element in increasing acceptance of the value of, and need for, FRe technologies.

This issue of integrative communication and consistency in communicating the message of risk is becoming more important in pursuit of the resilient Living with Water agenda, with individuals becoming increasingly expected to make their own judgements on the acceptance of risk with support from wider stakeholders, raising wider issues of social equity and environmental justice (White *et al*. 2009). The following section now examines the role of modelling and mapping as a tool for the built environment professional to influence FRe.

5.2 Modelling and mapping

The role of decision support tools, such as mapping and modelling, is critical to effectively assessing flood risk, but applying these mechanisms within a wider system or by multiple stakeholders is not commonplace. A key part of internal integration will be to ensure that Work Packages 2, 3 and 4 take this point on board.

The National Reviews revealed that all governments take responsibility for either national and/or regional flood risk assessments or mapping. In several countries surveyed, the responsibility for flood risk mapping falls to singular national Governments, or to executive agencies of national Governments (France, Greece). In Germany states are responsible for their own flood risk assessment. In other countries (the UK, Netherlands, Spain, Greece) flood risk is mapped by way of co-operation between national and regional/ local bodies. Several assessments include, or seek to include, socio-economic damage data. Broadly, two main forms of partnership are identifiable:

1. Instances where national bodies address large-scale flooding with regional/ local bodies responsible for addressing local flood types, such as groundwater flooding, surface water flooding, sewer flooding (UK, Netherlands);
2. Circumstances where national governmental bodies develop tools, methods and flood risk policy/standards but where regional/local governmental bodies undertake the risk assessment at regional/local level (Greece, Spain).

In the UK, governmental agencies (the Environment Agency, Scottish Environment Protection Agency, Northern Ireland Environment Agency) have an overview of the management of flood risk and produce nation-wide web-based flood risk maps. These maps are available to the general public, who can search by postcode for their areas. They combine detailed local data from modelling and mapping studies with information from a national model. For rivers, survey data concerning topography is combined with information on flows. For coastal areas, detailed survey data is combined with sea level and wave information. Where detailed mapping is not available, data is supplemented with national generalised modelling for all rivers with a catchment size greater than 3km^2. Crucially, the governmental agency web-based maps do not include pluvial flooding, but this is not stipulated. In England and Wales the EA has now produced a set of pluvial flood maps, which are not yet in the public domain and are based on a 1:200 year rainfall event with the drainage system at full capacity and a Digital Terrain Model which does not include infrastructure. The Flood and Water Management Act (Flood Risk Management Act (2009) in Scotland) will localise efforts to protect from flooding and will mean that for the first time, local authorities must chart surface water. However, how this will work in operation is open to interpretation. Broadly, although there will be more responsibility for local authorities, these are likely to have less funding.

Also in the UK, unitary, county and local councils have primary responsibility to manage local flood risks. Larger authorities will invariably commission Strategic Flood Risk Assessments (SFRAs) from the private sector. These will use all available data including local drainage, past events and hydraulic models (if existing), which can be useful when looking at a city from a system perspective. No single agency, however, compiles historic flood records and many SFRAs still lack data covering pluvial flooding. The private sector also produces improved resolution flood risk maps for the insurance industry and others who commission them, but these are not in the public domain. Many of these private sector consultants make extensive use of LIDAR (Light Detection and Ranging), radar, photogrammetry and detailed rainfall hyetographs and have developed their own hydraulic modelling software.

In Germany, Federal states are responsible for mapping watercourses that constitute a flood danger but considerable differences exist between them. In many cases the extent of areas inundated by the 1:100 year flood is mapped but inundation depths and flow

velocities are not. Some of these flood risk maps are web-based. In 2004 a private sector consultancy developed the “DACH Flood” software for the insurance industry in German-speaking Europe. It offers a probabilistic model to estimate financial losses and accumulation risk. The model uses a rainfall-runoff approach and models flood intensities at certain points, quantifying water depth, flow velocity and effects of debris impact. These parameters are related to damage using a series of vulnerability functions, by considering insurance claim information, analysing engineering data and academic studies. The model is further calibrated to include gauge station data and historical flood data. An upgrade of the original DACH model enables insurers to assess building asset exposure along major German rivers and their tributaries. It includes a non-riverine flooding component.

In France, the governmental public works directorate is responsible for assessing and mapping flood risk, and has commissioned a private consultancy which has produced regional flood risk maps. Some groupings of local authorities have also developed their own flood risk assessments. There are no national standards and each authority uses different data, including historical high water records which are often used to assess an estimated 1:100 flood. The lack of input data severely constrains the quality of the French national flood risk assessment and maps. It is hoped that this situation will be improved through the EU Floods Directive.

In The Netherlands, the state, the provinces and the water boards are working together to instigate the ‘Safety of the Netherlands’ programme. This is mapping flood risk and potential damage in all dike-ring areas by 2011. Flood extent, flood depth, number of exposed citizens and economic activity are mapped for areas at risk of overtopping under normative conditions from rivers/coasts in simulations of 1:10, 1:100 and 1:1000 year events. Pluvial flooding and groundwater flooding are not taken into account and the maps describe only a limited amount of flood characteristics (i.e. flood depth and extent). The maps will be web-based when available.

In Spain, responsibility for flood risk assessment takes the form of a collaboration between municipalities, autonomous regions, civil defence organisations, hydrographical public bodies and the Ministry of the Environment, which is developing a toolbox for a national cartographic system. Web applications have been developed to display these maps. A 1:100 event defines danger zones and risk is assessed using hydrology, meteorology, geo-morphology, hydraulic assessments, historic records, land development scenarios (natural and developed) and rainfall data. The mapping, however, must contend with limited input data and model calibration. The interaction between fluvial and coastal flood models has not been resolved and pluvial flood risk assessment is restricted to high-risk areas only.

So far in Greece, risk maps have been locally generated with no specific template and usually in the context of local research. Regional water departments in collaboration with the Directorate of Civil Protection are developing maps showing 1:1000, 1:100 and 1:50 flood events, including socio-economic consequences and other information deemed useful, such as identifying areas subjected to floods with a high content of transported sediments and floods which can cause landslides or mud flows. The preliminary flood risk assessment, flood hazard maps, flood risk maps and plans for flood risk management will, in due course, be made available to the public.

National and regional flood risk assessments and maps are, as yet, unavailable in Cyprus.

The EU Floods Directive requires authorities responsible for flood risk management to create, by 22nd December 2013, flood risk reports and maps, flood hazard maps and flood risk maps and flood risk management plans. These plans must include measures relating to prevention and protection, which holds potential for FRe but does not explicitly address any details. However, the Directive also states that 'flood' means the temporary covering by water of land not normally covered by water. This includes floods from rivers, mountain torrents, Mediterranean ephemeral water courses, and floods from the sea in coastal areas, but *excludes* floods from sewerage systems (EU 2007). The exclusion of floods from sewerage systems suggests an acknowledgement that assessments of localised pluvial flood risk is challenging. This is an important omission considering the shift in risk towards pluvial sources in many urbanised areas and hampers the potential for both a system approach and the widespread application of FRe. In reality FRe could be used effectively to address pluvial flooding, but without accurate mapping of areas at risk, it is difficult to persuade people and decision-makers that protection is necessary.

For the most part, the EU Floods Directive has been welcomed across the National Reviews for creating a more systematic approach of mapping based on watershed/catchment areas (France); a more explicit division of responsibilities between 'national' and 'local' flood risk (UK); and potentially too the integration of EU guidelines into existing legal frameworks (Netherlands).

The general public, for want of better knowledge, are prone to accept national web based flood risk maps as 'truth' and is invariably unaware of their limitations. The existences of caveats or information deficits, such as will be well-known to those compiling the maps, are generally not well communicated to the public. For example, the public may not be aware that pluvial flooding is excluded from mapping, and therefore conclude they are not at risk, creating a false sense of security. This can be of particular relevance to property transactions and also to the uptake of FRe resilience measures. Furthermore, climate change is inducing ever greater storm intensity and unpredictability, and it is unclear as to

how often the maps are updated to reflect this changing dynamic. The difficulty in accurately assessing storm severity and the geographical areas affected means that the assessment and the mapping of flash flooding and localised pluvial flooding is likely to continue to be inherently inaccurate. This highlights the importance of maintaining robust and transparent data bases of all past flood events.

The development of tools such as LIDAR and photogrammetric technologies, coupled with improved meteorological and flood modelling techniques, creates more accurate flood risk assessments. Mapping too is constantly being improved. Private agencies supplement data available from governmental agencies with their own databases and models to provide high resolution tailored flood risk assessment and mapping services to the insurance industry, developers, Local Authorities, and others with the financial ability to commission them. These privately commissioned assessments and maps may be considerably more effective than the maps which are produced by, or for, governmental agencies for the public domain, creating exclusive domains of knowledge and make integration more difficult. Integration of data and mapping approaches can also be hindered by restrictive intellectual property and the maintenance of data sets for commercial purposes.

Turning to FRe there are some key aspects which are worth highlighting. The first regards the varying thresholds used in decision making; for example: what is the scale of event to be mapped? Will it include pluvial flooding? What do any damage assessments include? Will it be available for the public access? Will it be made available electronically? If it is widely available, how will caveats be communicated? Each of these issues has the potential to sway decision making on FRe and influence its application. For example, across all the National Reviews it was acknowledged that there may be vested interests in not acknowledging flood risk, not least political and social pressures upon planners to facilitate development, particularly housing. There are similar efforts from within powerful factions of the construction industry to promote development. Furthermore, it has been asserted that an acknowledgement of risk equals liability. Whilst having decision support tools can greatly aid FRe, in practice, more extensive information can also undermine efforts to integrate FRe.

It can be argued that flood risk assessment and mapping is an important component of a FRe resilience system. Widely disseminated high quality risk assessments and maps are able to accurately predict the probability and extent of *all* types of flooding, promoting not only flood risk awareness but also the uptake of smart FRe systems and products. The Flood Directive's requirements to include, where appropriate, information on water depths and flow velocity further underwrites the need for resilience measures. Conversely, it can also be argued that a lack of accurate predictions of flood risk in heavily built-up and storm prone urban areas – today increasingly at risk of flooding from the sewerage

system and from run-off - means that flood risk management authorities and the public would be well advised to look to FRe resilience measure for protection. The inclusion of an element of damage assessment could theoretically also lead to inclusion of use of FRe resilience products as part of the risk assessment. SMARTeST Work Package 3 will be studying both the DACH flood software and other flood mapping systems being developed by the private sector and will investigate their potential to be linked to the HOWAD damage assessment model being explored in Work Package 4. Taken together these may go some way towards the development of 'smart' flood risk assessment and mapping. There is undoubtedly a need for integration in how modelling and mapping is conducted and communicated within the EU. The Flood Directive is going some way to addressing this deficit.

All assessments are compromised by a lack of data and none of the flood risk maps available to the general public include an assessment of pluvial flooding. Assessments tend to look only at fluvial/coastal flooding critically ignoring localised pluvial flooding; a flood risk that as noted earlier is increasing across Europe. Whilst in the UK pluvial flood risk maps are produced, these are only available under license and are not available to the general public. In Spain pluvial flood risk mapping is restricted to certain 'high risk' areas), but is not commonly practiced. Given the disparate responsibilities for flood risk mapping, and divergence in how this is conducted, some countries do not possess national standards on how to assess flood risks with, for example, regional or local authorities locally generating different models and use different types and resolutions of data and present results in non-uniform formats/ outputs (France).

In summary, across all countries that submitted a National Review, it was reported that flood risk assessments take place using hydraulic and hydrological models. However, the development of the models, and their application to assess flood risk, face considerable inconsistencies throughout Europe. Partners report that models strongly rely on the available data describing the physical (flooding) system yet this data is not always available for all flood cases presenting limiting comprehensive modelling. As noted, consultants are often commissioned to produce flood risk maps (UK, Netherlands, and France). However, there is inconsistency here. Flood risk map production may differ between responsible authorities or consultancies whilst the outputs of flood models vary across Project partner countries. Moreover, few countries currently conduct comprehensive damage modelling or do not yet have fully developed damage models. The National Reviews identify further methodological challenges important to flood risk assessments, particularly concerning uncertainty regarding the availability and quality of the data describing the physical system; a comprehensive overview of all (flood defence) structures and failure mechanisms; calibration data; and a detailed data set describing urban structures and drainage infrastructures. The National Review survey also reveals potential variance in the quality and resolution of flood risk assessments and maps.

5.3 Built Environment Professionals

Flood Risk Management should be managed by a number of actors and agencies, and a key position is occupied by planners, architects and other professions connected with the built environment, using the best tools available to inform decisions. For example, within the UK efforts are taken to ensure risk is accounted for throughout the planning process. The aim is to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas at highest risk. Where necessary, policy aims to ensure development is safe without increasing risk elsewhere and to ideally reduce flood risk overall. Similarly, in France, planners can establish guidelines for influencing the uptake of FRe systems and technology. For instance, at the town scale 'prevention risk zoning' is elaborated in order to improve resilience and reduce vulnerability. As it can influence the location, design and materials used within development, the planning system and related agencies are integral to implementing FRe across Europe.

Spain provides a further example, where in accordance with the National Hydrological Plan, land under flood risk must be preserved from development. Hence, spatial planners are forced to classify land at municipal level as "*land specially protected, unsuitable for development*" and set it aside from the development process. Amendments to the Land Use Act in 2008 introduced a general prescription whereby all land which is not classified as developed or suitable for development should be seen as inappropriate, implying a generic protection exists across all land subject to flood risk.

Across Europe rules regarding construction in flood prone areas can 'red-line' or 'lock out' vast swathes of land from development. Areas classed as unsuitable for development because of high flood risk forego income from development. Yet conversely, several National Reviews (particularly France, Germany, the Netherlands and the UK) reported a conflicting message that these national Governments are currently pursuing efforts to *liberalise* the spatial planning system, relaxing restrictions on gaining planning permission, and releasing previously undeveloped land for construction. Similarly, the Cypriot National Review reports that the ceasing of building in areas at flood risk or abandoning coastal areas is in fact unrealistic. As such land firstly becomes *available* for commercial exploitation and secondly become commercially *attractive* for developers and potential users and buyers, new markets for flood defences, including flood resilience tools, technologies and systems, will emerge. In a practical sense, sites that have previously been considered as 'too risky' for exploitation can now be afforded more effective protection, and may even under some instances be *marketed* as 'safe' or resilient. This relaxation of development control may also in itself facilitate the installation of resilient features; planning permission in many instances is now not required for the installation of such features. Moreover, if subsequent FRe measures make areas suitable

for development, great benefits may be accrued through increased taxation revenues and through increases in property values. However, the relaxation of (municipal) restrictions on land development can only be acceptable if the risk in minimised (through FRe measures) or compensated.

Recognising the significance of this evolution, several Governments have drafted a suite of guides and protocols to help decision-makers adapt their approaches to accommodate these land-use alterations, and more broadly to gain acceptance for building on flood plains and to support citizens' capacity to 'live with water'. This has been viewed as an attempt to *normalise* flood resilience features – a paradigmatic shift to help living with water become accepted within the national psyche, and to help create resilient societies. Part of this effort has entailed the drafting of guides for the integration of flood resilience features into the built environment. For example, France's Environment Ministry is developing a guide dedicated to 'building in flooding' areas. This document was produced by several workshops with stakeholders, including central state representatives and experts of the CEPRI (Centre Européen de Prévention du Risque Inondation – a State Agency in charge of promoting flood risk prevention). France has a risk prevention fund - National Fund for Natural Hazard Prevention – which could be also used to help facilitate the integration of flood resilience features.

German sub-national states have started to issue advisory reports of FRe techniques including flood-proofing and construction materials on floodplains to be used at the city planning scale, including matrices of measures to be used for new developments and for the retrofitting of existing developments[10]. It should also be noted that although expanding, it was reported in some National Reviews and in several UK NSG meetings that there remains a dearth of guidance to support the capacity of stakeholders to assume responsibility for FRe uptake.

Professionals in this area need to understand how best to interpret risk models, engage with uncertainty, communicate messages, and translate interactions into FRe decisions that limit long-term impacts. With regard to spatial planning, the recent spate of natural disasters within cities has highlighted the need to engage with the risk management agenda, but planning has an imperfect ability to consider risk as a whole due to artificial professional and policy boundaries. For example, planning's powers tend to focus upon *new development*, centre on the *built environment* and often are applied at inappropriate *spatial scales* for flooding. The National Reviews specifically highlighted the limited potential of planning to enforce both the retrofitting of FRe technology and an integrated system approach crossing multiple spatial scales. For example, the Spanish Review

[10] Hochwasserfibel – Bauvorsorge in Hochwassergefährdeten Gebieten. Ministerium für Umwelt, Raumordnung und Landwirtschaft des Landes Nordrhein-Westfalen, 1999

identified that where buildings are in areas that have been subsequently classified as unsuitable for development due to flood risk in municipal plans, they may be demolished without an indemnity, compulsory purchased for immediate demolition, or declared as ”incompatible with the existing planning situation”. In these cases FRe may offer potential for compromise. Given these circumstances, the FRe system approach and more innovative tools developed within the SMARTeST project do offer potential for flood mitigation.

In planning, although resilience is a relatively new concept it is starting to become linked with policy. Significantly for the application of FRe however, flood risk is usually applied and interpreted in a narrow and procedural manner, perhaps reflecting the unclear nature of spatial planning. Therefore, to integrate with decision-making, FRe itself must adapt to the usual long-standing approach to managing land and buildings. The use of Flood Risk Assessments provides a good example, as they are designed to supply a firm estimate of the probability of inundation and provide an indication of how flood risk can be compared against other concerns. Although this enables flood risk to be assessed within planning practice, evidence from practicing planners suggests that they are unsure regarding the authority claimed by deterministic probabilistic judgements, as in practice perceived risk is stochastic and uncertain (White and Richards 2007). This aspect links to the previous section on how the perception and communication of risk may inhibit resilient action; FRe needs to be understood and mainstreamed within the mindset of planners if it is to be applied. Currently however, a common theme within *every* National Review was that despite their pivotal position, planners have a lack of understanding regarding FRe and its practical application. If this issue was tackled planners could play a much more proactive role. For example, the German National Review highlights that formulating ‘learning coalitions’ can place the planner in the important, trusted position of a mediator in facilitating FRe. However, this collaborative approach also needs to recognise that stakeholders may pursue vested interests and transparent agendas should be established.

In practice built environment professionals have a limited understanding of risk and may in fact be institutionally inhibited from pursuing such notions as increasing resilience. For example, they may consider flood risks in a simple reactive manner alongside development proposals, whilst FRe can also operate from a proactive outlook and creates the potential to address resilience on a more systemic and long term basis. Built environment professionals also have to consider what may be competing ‘risks’, such as economic decline or environmental threats. In addition, the rapid emergence of risk within the field has uncovered difficulties in interpretation. All the National Reviews highlight how these stakeholders are relatively new to flood risk management and have a limited understanding of FRe. Given these issues, the sector currently faces institutional challenges to becoming effective agents of FRe.

Aspects of these problems are surmountable however, as in cases where an accurate value of risk is impossible to calculate, risk and uncertainty become a matter of judgment. It therefore connects with the core skill set of the planner, as an agent trained to weigh sometimes competing agendas. Planners, and people in general, may deal with uncertainty by following societal messages and guidelines, and if a detriment does happen they are thus able to feel confident they acted rationally and correctly. Therefore, the process of calculating risk, weighing the potential of FRe and using it as a basis for judgement can be attractive as a mechanism to immunize decision making from perceived failure (Reith 2009). FRe may therefore be a useful option for planners, as it may become a mainstream precautionary approach once development proposals have been accepted. This could lessen the fear of liability that was highlighted within the National Reviews. This point does however, link with the need to communicate the nuances of risk and the role of FRe better to planners and, perhaps more importantly, to the general public. There may be a need to scale back the inherent claims to scientific authority in risk communication and instead convey the uncertainties involved in risk management, allowing the individual to take informed responsibility. Importantly, this would help link the Living with Water agenda with the potential widespread application of FRe.

5.4 The Construction Sector

The construction sector has suffered significantly in the economic downturn experienced throughout most European countries and elsewhere. Although in the UK recent growth in the sector has provided some optimism, it is likely that growth figures will fluctuate in the coming years, and is unlikely to reach the levels recorded in 2006/07. The economics of the sector will have a direct impact on the development of FRe within the built environment. It is apparent that the construction industry sectors (civil engineering, manufacturers, contractors, SMEs, etc) are focusing on financial stability and marginal growth, and not on the development and integration of new technologies or approaches. Year-on-year cuts to public sector budgets are also predicted over the coming years which will further limit the commissioning of ‘non-essential’ maintenance or new-build works, including those for flood management.

That said, the number of FRe products available on the market continues to grow. This, coupled with the continued activity within the repair and maintenance sector, provides opportunities for the wider acceptance and implementation of FRe. The reviews revealed, however, there is a well-grounded perception that the construction techniques and materials are both *difficult* to source, and may be more *costly* to purchase, install and maintain. They also require careful planning, detailed safety and risk assessments and robust design and engineering as the consequences of system component failure are so

much greater than when avoiding the risk in the first place. Therefore, they may be seen as more complex to use than traditional techniques.

Moreover, due to financial constraints within the construction sector, the cost of flood management strategies must be carefully considered. In many parts of the EU, urban flooding is tackled with household or property protection measures no more sophisticated than sand-bags. This low-cost option operates effectively in certain circumstances; however it has limitations in areas of seasonal flooding. The combined effects of urbanisation and climatic changes require a greater level of considered flood protection, which should include strategic warning systems, local defences and house or property protection products. So whilst the Construction sector is in many instances driving towards a smart, integrated approach, it is constrained in many instances by finances. A further barrier can be lack of skills and knowledge about FRe in the construction sector, a common barrier to uptake of new approaches to building in an inherently conservative industry. Profit margins in the sector are heavily influenced by an ability to repeat well tried processes and approaches to building that are acceptable for clients (Adams 1994) – it is this normality that FRe needs to adapt to.

Importantly, the construction sector will respond to customer and client demand, which means that the perception of risk and the efficacy of FRe by both built environment professionals and communities will play a key driving role. This demand can be stimulated in a number of ways (legislation, regulation, public perceptions, insurance, etc.) and that demand will vary across different geographical areas. Significantly, the sector can also stimulate demand by, for example, designing innovative buildings that are desirable places to live. The data collection has revealed that awareness is strongly related to recent experience of flooding, which in turn creates both the political and social will to engage with FRe. Notwithstanding this link, in many urbanised areas, the management of surface water and associated flooding problems has earned greater levels of appreciation and consideration from decision makers and members of the public. This will continue to grow as instances of urban flooding increase and the regulatory frameworks become established, particularly where large-scale engineering approaches may not be deemed cost effective. This combination of public awareness and client demand will create greater opportunities for the integration of FRe throughout the built environment.

As yet, however, the National Reviews in each country revealed that there is not sufficient guidance available concerning flood resilient materials or flood resilient building design. Many in the construction sector still have a perception that water is an enemy of buildings. In France for example, all construction rules were designed in order to avoid situations where construction materials would be in prolonged contact with water. The rules to avoid condensation, to drain surface or underground water from foundations and

walls, to protect walls from heavy rains illustrate this assertion. In addition to professional and public acceptability, the NSG workshops have also revealed further hurdles to be negotiated, not least the costs of FRe in comparison to typical construction methods and materials, and information on technological FRe options and their performance.

The construction sector will be more accepting of FRe if its long-term benefits can be measured in both performance and financial terms. There is, therefore, a responsibility for wider FRe stakeholders to provide accurate and considered information to support the development of FRe within the construction industry. This could be reported on a case-study basis where tangible and measurable benefits have been returned by the integration of FRe. Of equal importance to the construction sector, particularly in times of austerity, is cost-benefit information. This data should be recorded in tandem with performance benefits to ensure the implementation of FRe on a wide scale. If FRe is deemed to be cost effective, it would also help sway consumers to demand its increasing utilisation. There was an example cited within the NSGs where some house builders have used FRe as a selling point, helping them to dispose of their existing land bank. This is an example where more information and acceptance can prove positive for the sector. Work Package 2 of SMARTeST is designed to help address some of the technical issues highlighted here.

5.5 Insurance Sector

The National Reviews revealed that there are great variations in the manner in which flood risk insurance is provided amongst the SMARTeST partner countries. Flood insurance is compulsory in France and Spain. In all other countries surveyed it is voluntary, although invariably imposed as a condition for obtaining a mortgage. In the Netherlands it is, with certain limitations, provided by the State. The only country within the SMARTeST consortium to provide universal flood insurance is Spain. In the UK and Germany the provision of insurance can be subject to the risk assessment of a particular area and both the Netherlands and France also differentiate between flood and weather intensities with regards to insurance.

In the UK, Greece and Cyprus, flood insurance is generally provided as part of a household insurance policy, but this does not occur in all cases. For example 25% of the houses flooded in the UK in 2007 were not fully insured. Private insurance companies will assess risk and previous claims history and take punitive measures accordingly, although in Cyprus, Germany and France flood victims not covered by insurance have been compensated by Government. However, in Germany compensation by the Government is declining as more and more Federal States introduce decree-laws, which rule out subsidies in cases the homeowner could have purchased insurance cover but refrained to do so (e.g. Bavaria and Saxony). In the UK, under the Association of British Insurers

(ABI) Statement of Principles, insurers will provide flood cover as a standard feature of household and small business policies until 2013 for a) those properties defended to a minimum standard of 1 in 75, or b) for those properties where such defences are scheduled for completion within the next five years. Premiums will continue to reflect different degrees of risk. The ABI has warned that this Agreement will expire unless the Government increases the amount of money it spends on flood protection.

In Germany flood insurance is only provided by private companies. It is available for all buildings, even in the most flood hazard prone areas. Approximately 1.5 % of all buildings are located in those areas. However, in flood hazard prone areas, additional prevention measures have to be taken, before insurance cover is provided. Nevertheless, there might be no economically worthwhile insurance solution if no additional prevention measures are taken. Insurance premiums for an average building start from around €50 p.a. in low risk areas up to around €400 p.a. in the most exposed areas. The individual risk assessment of each building by the insurers is mostly done by the GIS risk mapping system "ZÜRS Geo" covering 4 risk zones with different flood return periods (GK1: more than 200 years, GK2: 51 to 200 years, GK3: 11 to 50 years, GK4: 0 to 10 years). While insurers offer natcat-insurance, including the cover against flooding and heavy rain very actively recently, demand by the customers is still moderate due to a lack of risk awareness. The average market penetration of natcat-cover was around 30 % at the end of 2010. The Federal states and the insurance industry have teamed up to increase risk awareness and market penetration by mounting natcat-insurance campaigns (e.g. in Bavaria, http://www.elementar-versichern.bayern.de/). Additionally, the insurance industry will open up the ZÜRS Geo system for the public ("ZÜRS public") providing information in common speech and avoiding any technical terms.

In France, natural disaster insurance (which includes flooding) is compulsory; it is regulated by the government and is provided by the private insurance sector with the government offering guaranteed reinsurance and imposing a natural disaster levy on top of the premium of basic property policies (currently 12% although there is a proposal to increase this to 14%). To be eligible, a flood must be recognised as a natural catastrophe (generally when the flood exceeds a 1:10 year event).

In the Netherlands the government compensates for riverine, sea and groundwater flooding but only provides compensation when a flood creates a considerable disruption of public safety. Pluvial flooding is also not specifically covered, although private companies will provide pluvial flood insurance subject to specified rainfall intensities. Whilst only pluvial flooding is subject to punitive measures it is at times unclear in which cases flood damage will be compensated.

In Spain, flood risk insurance is also compulsory within the framework of the Spanish natural catastrophe coverage system where property, personal accidents and life insurance must include flood. Insurance is provided and indemnified by CCS (Consorcio de Compensación de Seguros, the Insurance Consortium), a public entity working in collaboration with the private market. Punitive measures are not imposed, and the cost to the insured is kept low. The Spanish National Review notes that further individual insurance against natural hazards is much more widespread among farmers and other income-generating (industrial) activities.

It can be seen from this synthesis of information from the National Reviews that the level of protection across Europe varies greatly. This implies that the road to market for FRe is complex from an insurance perspective and subject to fragmentation. This makes it difficult for FRe companies to operate across national boundaries and also affects how attractive FRe technology is perceived to be by citizens within each nation state. For example, it would appear that the Dutch, French and Spanish schemes, which receive governmental backing, offer potential flood victims with a good level of protection but the Spanish scheme is the only one to offer fully universal coverage.

Beyond the general approaches to flood insurance, the role of the insurance sector has further influences on the uptake of FRe. The insurance industry does not, in principle, provide direct financial assistance for FRe in any of the countries surveyed, although in the UK and in other countries, insurers publicise FRe and provide general flood mitigation advice, including limited advice on FRe measures. The fact that the insurance industry does not provide direct financial assistance for FRe is to be expected: the role of the insurance industry is the transfer of risk, not the financing of additional measures.

In the UK, Greece and Cyprus, all insurance companies are independent and in competition and are, in general, inactive in directly financing flood resilience. In the UK, ‘no betterment’ clauses prevent insurance companies from assisting in the finance of FRe products after any claim. However, in the UK insurers will occasionally stipulate that homeowners must adopt FRe prior to offering home insurance, therefore in some cases insurers will not insure if the repairs to a property are not ‘resilient’. Also, in the UK, insurers may part fund FRe for larger commercial clients where there is a large premium value. They do not, however, part fund at building level. Furthermore, the ABI consider that the Statement of Principles under which the insurers provide flood risk cover as part of household policies serves to reduce the incentives on property owners and local communities to invest in flood risk management. Despite offering potential, this approach to FRe is employed inconsistently in a competitive market.

In Germany insurance companies have been identified as being slow to adopt innovation, even when there may be substantial benefits to be gained. A study comparing flood

insurance programs in France, the UK, and the US found flood insurance in Germany to be the least effective in encouraging awareness of flood risks and proactive measures to mitigate losses (Majmudar 2009). Insurance companies in Germany also do not provide rate incentives for the installation of FRe features apart from a few exceptions. If FRe features in a discussion between insurer and policyholder, it is mostly in those cases where insurance cover can only be provided if flood prevention measures are installed first. However, since the study of Majmudar in 2009 the situation in Germany has changed significantly. Apart from the natcat-insurance campaigns mentioned earlier, the non-binding terms and conditions of the building and household insurance were totally rewritten. The natural catastrophe loss insurance that, hitherto, could only be additionally concluded in the past, is now included right from the outset, thereby providing additional protection against natural hazards. This comprehensive insurance solution will not only give people in areas prone to flooding more financial protection, but it will also raise the awareness of the general public to the need for protection against the consequences of natural hazards.

Furthermore, the German insurance industry is doing in-depth research on climate change and the future losses due to natural hazards. German insurers established a scientific cooperation between leading climate researchers and the insurance industry. Led by the German Insurance Association in Berlin, the researchers linked actual loss data of the insurers with a bunch of different climate models for the first time. The main focus lay on the perils “storm”, “hail” and “flooding” – the most common natcat perils in Germany (heavy rain will be studied in a future research). The scientific studies show that by the end of this century, losses due to flood events will most likely double, or, depending on the scenario, even triple. The German insurers published a list of demands to the government, cities and municipals and others, to prevent things from getting worse in the future (e.g. to stop providing building plots in known flood areas). The ultimate goal is an integrated approach of all parts of the society. The latest information is available on www.gdv.de/klimawandel.

In France, the organisation of the insurance industry by the State arguably hinders the uptake of FRe, because relative risk is not taken into account in the premium payable. Moreover, the French National Review Reports that this situation discourages the evolution of new practices and the embedding of alternative behaviours in risk management. However, there is a risk prevention fund provided by the State which offers potential. For instance, a private individual who wants to put barriers to protect their house, or a local authority, who would like to make an information campaign, can receive grants from this fund. This has also recently occurred in the UK, where communities can raise money to help lever in additional government funding.

In the Netherlands, where all flood risk except for pluvial flooding is covered by the State, there is no reason why the insurance industry should facilitate the uptake of FRe. For insurance companies, pluvial flood damages are relatively small compared to the overall damage claims they receive, and at present they do not appear to be especially interested in FRe.

In Spain, the CCS has also some prevention duties, which are carried out through a strategic plan promoting knowledge, research and prevention of natural perils. However, the private insurance companies which administer the Spanish insurance scheme are not involved in risk assessment and do not play an active role in promoting FRe. The scheme has proved to be so efficient at compensating flood victims it may negate incentives for the implementation of FRe measures and has become a barrier to their development.

The National Reviews revealed a number of ways in which the insurance industry may be able to facilitate FRe use. For example, the insurance industry could support the uptake of FRe through incentives such as premium reduction thus demanding provision of FRe because if it is functioning effectively it is arguably in their own interest to do so. To do this would, however, require more information and guidance concerning critical aspects such as installation, performance and ongoing maintenance. To foster trust this may need to be independent or established in partnership. However, the Greek National Review highlighted that in many cases the Government adopts the manufacturers' regulations and utilizes these as the basis for regulation, which in practice may not be accepted by other stakeholders. In a fragmented sector the importance of partnerships with utility companies, national and local government and the Agencies charged with managing flood risk are also seen as viable options to be explored.

As with the construction sector, a key driver is financial. Insurers could prove an enabling force for FRe, by for example, lowering premiums or excess. It was also suggested they could help incentivise individual investment by working with the government to establish a grant scheme or help lower the costs to the FRe sector by becoming more proactive in product development and marketing. Refitting flooded houses with resilience features offers further potential to lower costs if flooding reoccurs. In all circumstances, to help protect the homeowner and insurers it is essential that FRe is determined and installed effectively and is certified by a professional surveyor.

Whilst the role of the private sector has been championed by governments, this has not occurred in a consistent manner. Whilst national flood policies may encourage private sector involvement, the availability of national flood compensation schemes actively hinders their functionality. The National Reviews demonstrate the dichotomy between protecting the public's property from flood and compensating the public for damages caused by flood. The better the flood risk insurance, the more it would appear to

constrain the implementation of FRe measures at a local (household/ building) scale, by both the insurance industry and by individuals.

Therefore available and affordable state insurance (such as in France, the Netherlands and Spain) could be seen as a deterrent to the installation of FRe features. Where insurance is provided via the private sector without governmental support (such as in the UK, Germany, Greece and Cyprus) the industry can and in some cases already does, compensate customers who are at low risk of being flooded or have installed resilience measures - via lower premiums, reduced excesses, or even the provision of cover. As a matter of fact, neither state insurance nor private insurance has any advantages when it comes to the installation of FRe technology, because ultimately someone has to pay for it – by premiums or by taxes. The Reviews also highlight that where flood insurance is not subject to accurate weighting of relative risk and a diversity in the costs of premiums between areas the ability of FRe to penetrate markets is also undermined. Work Package 2 is considering the performance and relative costs of FRe technology, which should help provide clarity to some of the issues relevant to the insurance sector.

5.6 FRe sector

Across Europe a key stakeholder in FRe deployment and uptake is the FRe sector. It is here that the products are designed and developed, money is invested in marketing strategies and households and property owners are contacted to ascertain interest.

There is a continually developing range of commercially available flood protection products that can be installed to resist flood waters entering a building. The types of products available include door boards, proprietary airbricks and periscope vents, weep hole covers, flood skirts, flood resistant gates and walls, proprietary flood barriers and back flow valves for drainage systems. The purpose of all these products is to keep as much water as possible away from or out of the building.

In the UK, for example, some such products have been awarded a BSI Kitemark under a specific flood protection products scheme and these are recommended when making a selection (PAS 1188, BSI 2009). The products can have a maintenance requirement and many of the barrier techniques are temporary, that is they need to be manually installed prior to the flood. The PAS1188 is set out in four parts to reflect different types of technology that are available, as follows:

- Part 1: Building aperture products;
- Part 2: Temporary products;
- Part 3: Building skirt systems;

- Part 4: Demountable products.

This PAS specifies requirements for the designation, testing, factory production control, installation documentation and marking for different types and configurations of flood protection products. It is applicable to flood protection products intended for use in the temporary sealing of building apertures and entrances to properties, in the event of static flood water rising up to a level between 600 mm and 900 mm above ground level, except where they are designed to completely cover or replace small apertures, such as air-bricks or air vents.

There is normally a limit to the depth of flood water that a building can be protected against due to the pressure exerted by that water. A flood depth of one metre exerts half a tonne (or 5 kN) of force to each one metre length of wall. It is therefore important that any flood barrier and the existing structure is strong and stiff enough to withstand this loading, otherwise structural distress may occur. It is recommended that existing structures are inspected and assessed by a structural engineer before any barrier system is installed.

No debris impact is involved or durability is tested. These issues are however covered within a test protocol produced by FM Global (a certification business). The range of products that can be tested using the FM methods are similar to those tested by the PAS methods. The use of certified products, either to the PAS or FM Global standards does allow the entry of products into certain markets, in particular PAS deals with the UK market. The use of the certification should be accompanied by information from the manufacturer on the performance levels achieved for that particular product.

This protocol is intended for use in the UK or locations with similar exposures, i.e. where there is a temperate climate and advanced warning of flooding is available and specifies the method of testing and an allowable leakage rate, the ability to integrate guidance beyond the UK would therefore have to consider the various types of floods that may affect an area, in addition to more practical construction concerns.

Despite the potential for innovative and smart FRe to save millions in an age of austerity, a point of note is that the market is emerging and is currently dominated by small enterprises. This means that it is difficult for companies to benefit from economies of scale and many may not possess knowledge and skills concerning all aspects of the road to market ‘in-house’. Moreover, existing FRe companies or newcomers to the market wishing to develop an idea may only employ one or two people, making the time, complexity and cost of getting new products adopted in the market a key issue.

The difficulty and costs of bringing a product to the marketplace was specifically highlighted as a key barrier by FRe manufacturers. In the UK, two funds from central government (the Defra Research and Development budget and Department of Trade and Industry Partners in Innovation Fund) have recently been withdrawn, placing the onus on companies to invest heavily up-front and risk this against the possibility of future sales. As with the insurance sector, it appears that although governments are pushing for increased private sector contribution to flood risk management, differing departments may in fact undermine this possibility by assuming that innovation is always stifled by governmental intervention, rather than being facilitated by government innovation, such as in research and development and the creation of knowledge exchange partnerships.

In practice, it is expensive and risky for SMEs to bring an idea to fruition. In the UK it was estimated by the NSG that it costs around €35,000 to get a new product tested and another €35,000 to gain accreditation. But before even these steps, there is a need to conduct market research, which again costs money. Given the complexities of different understandings of risk and responsibility discussed above, testing the market for FRe is particularly challenging. This is not a market where it is possible to gauge the possible market for a well-understood value proposition. Indeed there may be reluctance to the very concept of the need for the householder or property owner to take on the management of risk through incorporating FRe into buildings.

This upfront financial outlay and uncertainty as to market acceptance excludes many SMEs from being active in the marketplace, and the FRe market is not yet mature enough for large companies to step in. It was also suggested that there may be a fear of innovation within flood risk management, which is inherently cautious and wary of liability issues. More data on FRe technical performance and best practice could prove an effective way to address this problem.

It was estimated within the data collection that it may only cost a few million pounds per annum in each country to subsidise the entire innovation market, and this could potentially pay itself many times over in reduced costs for damages over time. One suggestion was that a manufacturer could pay for the initial proof of concept, but that, if successful, grants could be available to subsidise its development. Another possibility highlighted was a clear path for SMEs to access an EU FRe Research and Development budget or to link FRe more tightly to the ‘green’ agenda to create the potential for wider sources of funding. This would require more joined up thinking between the two sectors however, as for example many recommended ‘green’ or ‘sustainable’ materials are not flood resilient, but the ability of FRe to achieve social or economic benefits may make these measures just as ‘sustainable’ as those made from environmentally friendly materials.

As highlighted in the insurance sector discussion, it is important to ensure that once FRe products are fitted, they are effective and have a positive financial benefit for the homeowner. Currently, there is an inconsistent view within the insurance sector; both with regard to the potential for lower charges or by increasing the amount of companies willing to quote, which may have the same effect of limiting uptake. It is therefore important FRe measures are installed and maintained correctly, and that data about their performance is made available to help assuage the insurance sector. Yet this can prove difficult, particularly as people move properties. One FRe manufacturer cited an example where one homeowner had installed a cat flap into their flood defence door, whilst new homeowners may not find the product aesthetically pleasing and remove it from the property. If FRe was linked to annual insurance premiums and excess however, it would raise awareness via the possibility of occasional maintenance inspections and annual financial benefits. In the UK it was noted that water companies are now beginning to engage with FRe as a cost effective way to manage pluvial flooding. In cases where they do pay for and fit FRe, they also maintain it for the lifetime of the product.

Uncertainty over the performance of products was highlighted in the insurance section and recognised by manufacturers as a barrier to integration with wider stakeholders and their potential widespread utilisation. AXA insurance argued for a standard insurer recommended certification scheme to ease the road to market. This could also be pushed at the EU level to support standardisation and facilitate sales beyond national borders.

As purchasers and users of FRe, manufacturers also emphasised the key role played by the public. In order to promote their products it was estimated by the UK NSG that marketing was an expensive element of their business. This is a significant financial commitment by the sector, and one that could be lessened in the future. Part of the problem in FRe use is the perception of flood risk held by citizens. If, for example, it is stated that a property may be at risk from a 1 in 75 event, it strengthens the view that it is an issue for the future. It was suggested that a move to a ‘traffic light’ system could help provide clarity to the public.

The National Reviews also revealed a consistent view that there may be strong objections to self-protection by the property owner, particularly if it requires them to pay for protective measures. Although the Living with Water agenda has gained momentum, it appears many citizens may be sceptical if it affects them financially and if it means accepting responsibility for managing risk as opposed to expecting the State to manage it. There was consequently an opinion amongst the FRe sector that there is a need for more education of users that it is their responsibility to manage flood risk, not the Local Authorities, National Governments or Environment Agencies. But politically, governments may be reticent to inform people of their estimated risk, with each flood currently seen as a ‘freak event’. For example, the French National Review highlighted a reticence to

emphasise the possibility of a major flood in the Greater Paris area by both the planners and citizens, which affects the potential to gain consensus on systemic resilience approaches.

There is a need for more integrated working between stakeholders. For example, in the UK the Environment Agency is responsible for informing people that they may be at risk from flooding, yet neither their letters to households nor their website link to the potential of FRe. The example of burglar alarms was also cited where people pay for alarms even though average cost of burglary is estimated at £1,000 and a flood at £30,000. Furthermore, the Fire Service work to promote smoke alarms, but the Environment Agency do not have any similar responsibility to engage with FRe and may need to be seen to be independent to avoid favouring any particular company.

Partnership working with communities and broader NGOs and stakeholders would also help to promote trust, which was identified as a key issue in a marketplace linked to the private sector. It was argued that engaging with communities is much more effective than leaflets and creates the potential for more systematic, community based responses. One good practice example was provided by the UK NSG, where an influential community advocate, a trusted figure and founder of the National Flood Forum a community based pressure group, goes independently into communities and demonstrates a range of products.

The data collection revealed that although there are a significant number of problems on the road to market there are opportunities to be explored. Perhaps unsurprisingly in a sector used to operating without government support, there were some innovative proposals. For example, it was thought that an independent body could be created to help represent the sector, which could push regulation and standards and lobby local and national governments for financial and business support in helping FRe reach the marketplace. The landscape may be too complex for an SME dominated market to affect a rapid and wide-spread uptake of new technologies without a coordinating body or wider assistance of some sort. One suggestion from the FRe manufacturers was developing a handbook, detailing how to get a product from an idea to the marketplace. This is a good example of integration; pooling knowledge from a range of stakeholders.

Integration across the EU in this area is challenging due to the relative different starting points and varying development challenges. The variety of testing, standards and accreditation across Europe hampers the road to market, as does the absence of financial support. In addition, best practice can play a valuable role and influence issues such as performance and trust, and link heavily to public engagement and participatory governance discussed in the previous chapter. These issues on the road to market will be explored in more depth as the SMARTeST project progresses.

5.7 Conclusion

The National Reviews highlighted that the EU Floods Directive and the Water Framework Directive have the potential to drive FRe development, and in particular to help change stakeholder practices. The need for interdisciplinary approaches will have implications on planning and decision-making, education in related professional fields and stakeholder participation processes. This may impact upon a wide range of professional groups: civil engineers, city planners, architects, landscape architects, economists, social and behavioural scientists, public health specialists, commercial interests, lawyers and other professional organizations, and resident and interest groups organized in NGOs (Tourbier and Ashley 2007). Addressing this deficit may require learning coalitions of stakeholders to facilitate implementation of flood risk management planning, potentially placing the planner into the role of mediator. Through such awareness and participation raising measures citizens may also support flood resilience planning projects and understand that they may need to take their own flood prevention measures. Unfortunately citizens are accustomed to flood control being the responsibility of government agencies. Further the National Reviews also highlighted that stakeholder engagement practices in this area may still be viewed as costly and time-consuming, hindering their widespread application.

The desire for stronger horizontal integration as a component of the move towards flood risk management demands a widening of engagement to consider the possible influences of all those stakeholders who can play a positive role in enabling the use of FRe. As outlined throughout this section, this new approach does bring new challenges, particularly concerning the development of understanding within and between sectors and the establishment of effective and reinforcing working protocols. One particular issue may be the varied and fragmented policy landscape across national boundaries. Although the Floods Directive will bring some integration, policy and practice is much more developed and established in some countries than others, in Greece for example, Greek Municipalities do not have a specific regulation regarding flood protection and tend to copy UK and French approaches. This may mean that best practice emanating from those countries at the FRe forefront may enable other nations to benefit quickly from their experience.

In essence all the stakeholders mentioned in this section perform a risk management service for individuals who work or live in cities, and the citizen implicitly believes that the home they purchase, renovate or insure has been deemed to be protected from flooding. That being said, whilst institutions or agencies may have key roles as risk managers, as hazards become more interrelated and complex, the contribution of the public in determining their own exposure and responses to it will become more important. The interpretation and communication of flood risk and the potential of resilience responses is

an issue stretching beyond the traditional understanding of the professional sphere; in reality the Living with Water agenda means that everyone is a ‘risk manager’ now. The next section introduces an analytical framework designed to help identify and address each issue that exerts an influence on the road to market for FRe.

6. DESIGNING AN ANALYTICAL FRAMEWORK

The translation of flood management innovations to practice depends upon their integration into flood risk management more generally, and the development process more specifically. Yet transition theory argues that technologies often have difficulties being accepted within the mainstream and that resistance is often situated at the level of institutions, technical systems, culture, and legislation, which requires reinforcement in social, cultural, economic and technical domains (De Graaf 2009).

This research is designed to identify and consider the manifold barriers and opportunities with the potential to affect FRe uptake and usage. The initial stage of the research revealed that there were a wider number of factors with the ability to influence FRe within differing steps of the road to market. It was also apparent, however, that some aspects stemmed from wider thematic issues, such as economic, technical or regulatory concerns, and an analytical framework was needed to encompass both the more linear product development cycle and the cross-cutting issues with the ability to influence its operation and effectiveness. This section discusses the rationale for, and content of, the selected approach.

6.1 Identifying the 'Road to Market' for FRe

Rogers (2003: 1), a key thinker in the study of the 'diffusion of innovations' argues that: "*Getting a new idea adopted, even when it has obvious advantages, is difficult*." He also notes that many innovations require a lengthy period, often many years, from the time they become available to the time when they are widely adopted. As discussed in the previous sections on integration, FRe faces a particular challenge, not just to demonstrate the relative advantage of new products, but to also overcome possible deep reluctance to the underlying concept of the need to take responsibility for risk. Therefore, in order to understand the issues at play influencing the utilisation of FRe, there was a need to identify the 'road to market'; the path from idea conception to product available for deployment to broad scale acceptance and use in practice.

The methodology initially examined the theoretical literature, running a stakeholder workshop with the UK NSG and interviewing key actors and agencies involved in developing FRe technology. New product development with regard to FRe can typically be understood as involving a linear, progressive process. The initial conception of the idea is quickly followed by a market research and development phase, where the market is researched before the product is designed, tested and (in some cases) accredited. Once the technology is ready to be launched more in depth consideration is given to the

marketplace, commercialisation strategies and promotion. The final aspect involves marketing, sales, customer acceptance, performance and ongoing maintenance. The FRe RTM process can therefore be summarised as being a three stage model: *Market Research and Development*; *Promotion and Acceptance*; and, *Implementation and Maintenance*. Barriers and opportunities will be explored at each stage of the process.

Table 6.1: The Three Stage FRe Road to Market

MARKET RESEARCH AND DEVELOPMENT	**Market research, developing the idea, design, testing and accreditation**
PROMOTION AND ACCEPTANCE	**Business analysis, commercialization, marketing, pricing, product promotion, social learning and partnership development**
IMPLEMENTATION AND MAINTENANCE	**Uptake, performance and ongoing operation**

6.2 Influences on the Road to Market

As the previous chapters have outlined, influences on FRe are manifold, varied, and can be greatly dependent upon national, institutional, socio-economic, local and other contexts. Therefore, for the sake of clarity and relevance across the EU, the analysis will be thematic – based along a series of key areas of analysis present in each case study area. There are a number of analytical methods available to consider and frame the broad barriers operating within society with the potential to influence the diffusion of FRe.

For example, Trudgill (1990) developed barrier theory when examining the factors that prevent the solving of environmental problems, taking the view that this approach can assist in the process of improvement by making the barriers that impede progress into clearer targets for action. He advocated that environmental problems could be viewed in terms of a process from *problem recognition*, to *problem acceptance*, to *resolution proposal*, to *resolution acceptance* to *implementation acceptance* and finally to *problem resolution*. To operationalise his approach he classified potential impediments in terms of what he called the AKTESP barriers, an acronym for barriers categorised as belonging to *Agreement, Knowledge, Technology, Economic, Social* and *Political* spheres. These barriers were loosely classed in a linear system, where for example, knowledge barriers would be addressed before the technology barrier stage.

Selman (2000) explored the barriers to effective environmental decision making and identified them in a similar vein as Trudgill, being *agreement, technological, economic, social* and *political* barriers. Watts and Selman (2004) further explored barrier theory and

biodiversity. The analysis of barriers to environmental decision-making was also analysed by Vigar (1997; 2000), who categorised the impediments to sustainable transport within *political, institutional, financial* and *behavioural* fields. Petts (2004) when exploring waste management decision processes identified the existence of *technical*, *institutional* and *cultural* barriers. Whilst researching the barriers to innovative treatment technologies, the United States Environment Protection Agency (USEPA) (2000) also adapted and developed barrier theory from the AKTESP approach, by identifying four categories as a viable framework for barrier analysis. The USEPA recognised the existence of similar barriers to Trudgill, but categorised the barriers differently, for example incorporating the knowledge and technology barriers under one heading concerning technical impediments. The four barrier headings developed by the USEPA were: *institutional*, *regulatory and legislative*, *technical,* and *financial and economic*. This framework was also used by Robinson (2004) when examining the barriers to the investigation and remediation of contaminated land. The European Commission further developed a barrier theory when investigating the barriers to environmentally orientated technology (European Commission 2004). Within the context of market impediments to water based environmental technology they identified barriers belonging to *technical, regulatory, economic* and *social* fields (European Commission 2003).

It should be noted that although the implementation of barrier theory by various academics and agencies may have utilised differing categories as a framework for understanding barriers to environmental improvements, the overall approach remains broadly similar. For example, Trudgill (1990) highlighted the benefit of identifying diverse barriers affecting a subject area and classifying them into groups, a view supported by the European Commission (2003; 2004) in their action plan to increase the use of environmental technologies. It was decided that as barrier theory had recently provided a proven framework for analysing barriers to environmental decision-making in similar fields, the approach would be adopted to inform this study.

Furthermore, a Political, Economic, Social and Technological analysis (PEST) provides a framework for a strategic review of a given phenomenon. The analysis is used widely by organisations engaged in horizon-scanning activities as it can provide a useful analytical framework for strategic planning. It is widely used in business environments, and is often used to assess and evaluate the forces that will impact upon the development of a market or a business. The PEST analysis has also migrated to other sectors, and has been adapted for use. For instance, some factors may be generally acknowledged to be more important than others when considering a sector. These may be weighted, or may be reappraised according to the details of the sector. Alternative versions of the framework have added Environmental or Legal as further elements of the review (PESTEL Analysis), whilst others still have added Demographic and Ethical factors (to give STEEPLED).

Although the differing categories identified as a framework to study barriers may have evolved over time from the AKTESP premise suggested by Trudgill (1990) to more recent groupings (European Commission 2003; 2004; Petts 2004) it should be recognised that the overarching theoretical approach, which advocates that identifying thematic barriers to environmental progress can assist in problem mitigation, remains unchanged. With regard to FRe, utilisation of this theoretical approach provides an effective mechanism to explore and understand these wider, complex aspects. The seven thematic groupings and their definitions, developed below with specific relevance to FRe, are consistent with contemporary research. They follow the broad approach, before developing a framework specific to the sector. The creation of distinct categories is appropriate, as although each of the groupings utilised in other research had merit, they were particular to areas, such as waste management or sustainable transport, accordingly they may not be suitable for this particular research. Table 6.2 details the selected cross-cutting FRe thematic influences.

Table 6.2: The FRe Thematic Influences (TRICEPS)

TECHNICAL	**Influences associated with design, development and technical issues**
REGULATORY AND LEGISLATIVE	**Influences imposed by legislatures and government agencies through the existence or absence of statutes, regulations and policies.**
INSTITUTIONAL	**Influences that stem from the internal workings or functions of entities that are stakeholders in FRe use.**
CULTURAL	**Influences associated with the cultural perspectives of FRe stakeholders.**
ECONOMIC	**Influences associated with the economics of FRe use.**
POLITICAL	**Influences according to policy and related agenda setting.**
SOCIAL	**Influences connected to civil society and social justice, including analysis of partnership working and social learning.**

These categories were selected for a number of reasons. Firstly, they relate directly to FRe, as each of the groupings had emerged from the literature review, interviews, National Reviews, NSG feedback and workshops as areas presenting difficulties. Secondly, whilst investigating this theoretical approach, it became apparent that there were trends within many of the categories identified by other researchers in similar fields. For example, institutional barriers were recognised by Petts (2004), the USEPA (2000) and Vigar (1997), whilst the European Commission (2003), Trudgill (1990) and Selman (2000) had acknowledged the importance of technical and economic barriers. A category specifically regarding cultural aspects was included as not only had Petts (2004) and Robinson (2004) stressed its importance, but the literature review had also revealed that FRe seemed to experience particular problems in this area. Potentially intractable

barriers relating to perceptions of risk, responsibility and a deeply ingrained cultural reliance on large-scale engineering solutions have already been identified in the analysis of the national reviews. Thus cultural barriers will need to be addressed to enable the design of solutions that can take these often hidden challenges into account.

6.3 Conclusion

Combining the road to market and thematic influences of FRe an analytical framework to be applied in Deliverable 5.2 a framework may be constructed to better understand which barriers and opportunities relating to specific areas are active at each stage of the process (see Table 6.3). Identifying and categorising issues in this manner is designed to focus attention on key aspects, both making the reasons for not solving problems easier to identify and tackle (Petts 2004; Robinson 2004; Trudgill 1990; White 2005) and highlighting areas of best practice. It is an approach specifically designed to allocate attention (March and Olsen 1989) and facilitate change and may be considered a heuristic device to analyse FRe opportunities and difficulties.

Deliverable 5.2 will also draw on both the social learning (Tippett *et al*. 2005; Pahl-Wostl *et al.* 2008; Ison and Watson 2007) and systems-based diffusion of innovation literatures (Coenen and López 2010; Rogers 2003; Rogers *et al.* 2008; Sterner and Turnheim 2009), bringing in a body of knowledge aimed at wide-scale and rapid spread of new ideas and changes in perception and behaviour. The aim is then to use the data within the analytical framework to develop a set of recommendations in Deliverable 5.3 that will encourage effective innovation, promote the wide scale diffusion of FRe innovations, and build the capacity skills and knowledge needed for effective uptake and management of these systems in practice.

Table 6.3: The FRe Analytical Framework to help identify key issues

	RESEARCH AND DEVELOPMENT	PROMOTION AND ACCEPTANCE	IMPLEMENTATION AND MAINTENANCE
TECHNICAL			
REGULATORY AND LEGISLATIVE			
INSTITUTIONAL			
CULTURAL			
ECONOMIC			
POLITICAL			
SOCIAL			

Therefore Deliverable 5.2 will begin the process of populating the analytical framework before Deliverable 5.3 will address these specific barriers and suggest strategies to facilitate FRe at strategic and local levels.

REFERENCES

Adams, D. (1994) *Urban Planning and the Development Process*, Routledge: London.

Adams, J. (1995) *Risk*, London: University College London Press.

Adger, N. W, Hughes, T. P., Folke, C., Carpenter, S. R. and Rockström, J. (2005) "Social-Ecological Resilience to Coastal Disasters." *Science* 309 (5737): 1036 - 1039.

Anderson, MF and Liefferink, D. (1997) European Environmental Policy: The Pioneers, Manchester University press, Manchester.

Ashley, R., Blanksby, J., Maguire, T. & Leah, T. (2010) 'Frameworks for adapting to flood risk: experiences from the EU's flood resilience city project'. Presented to International Association for Hydro-Environment Engineering and Research (IAHR), Edinburgh, UK, 4th – 6th May 2010.

Baker, S. et al. (1997) The Politics of Sustainable Development: Theory, Policy and Practice Within the European Union, Routledge, London.

Barnes, P.M. and Barnes, I (1999) *Environmental Policy in the European Union*. Edward Elgar, Cheltenham.

Beck, U. (1992) *Risk Society – towards a new modernity*, London: Sage.

Cabinet Office (2008) *The National Security Strategy of the United Kingdom: security in an interdependent world*, London: Cabinet Office.

Carpenter, R. A. (1995). *Limitations in Measuring Ecosystem Sustainability. A sustainable world: defining and measuring sustainable development*. In T. C. Trzyna. Sacramento and Claremont, Published for IUCN - The World Conservation Union by the International Center for the Environment and Public Policy**:** 175-197.

Cleaver, F. (2001) 'Institutions, Agency and the Limitations of Participatory Approaches to Development'. In Cooke, B. and Kothari, U. (Eds) *Participation - The New Tyranny?*London, Zed Books: 36 - 55.

Coenen, F.J. López, D (2010) Comparing systems approaches to innovation and technological change for sustainable and competitive economies: an explorative study

into conceptual commonalities, differences and complementarities, *Journal of Cleaner Production* 18: 1149-1160.

Costanza, R., Low, B., Ostrom, E. and Wilson, J. (2000) *Institutions, Ecosystems, and Sustainability*. 1st ed. CRC Press.

Darnton, A., Elster-Jones, J., Lucas, K. and Brooks, M. (2006) *Promoting Pro-Environmental Behaviour: Existing Evidence to Inform Better Policy Making*. London: The Centre for Sustainable Development University of Westminster, commissioned by DEFRA.

de Graaf, R. (2009) Innovations in urban water management to reduce the vulnerability of cities. PhD thesis, Delft University of Technology.

Defra (2005) *Making space for water: developing a new Government strategy for flood and coastal erosion risk management in England*, London: Defra.

de Pauw, N. (1996) Conclusions and recommendations of the International Symposium 'Environmental Impact Assessment in Water Management, Bruges, 15 - 17 May 1995. *European Water Pollution Control* **6**(1): 68 - 69.

Doppelt, B. (2003). *Leading Change Toward Sustainability - A Change-Management Guide for Business, Government and Civil Society*. Sheffield: Greenleaf.

Douglas, I., Garvin, S., Lawson, N., Richards, J., Tippett, J. and White, I. "Urban pluvial flooding: a qualitative case study of cause, effect and non structural mitigation." *Journal of Flood Risk Management* 3 (2010) : 112-125.

Douglas, M. and Wildavsky, A. (1983) *Risk and Culture: an essay on the selection of technical and environmental dangers*, Berkeley: University of California Press.

Environment Agency (2005) *Living with the Risk: the floods in Boscastle and North Cornwall, 16th August 2004*, Exeter: Environment Agency.

Environment Agency (2009) *Flooding in England: A National Assessment Of Flood Risk*, Bristol: Environment Agency.

Estella, A. (2002) The EU Principle of Subsidiarity and its Critique, OUP, Oxford.

European Commission (2003) *Developing an Action Plan for Environmental Technology*, Com/2003/131.

European Commission (2004) *Stimulating Technologies for Sustainable Development: An Environmental Technologies Action Plan for the European Union*, Com/2004/0038.

European Commission (2004) Communication on Flood risk management; Flood prevention, protection and mitigation. Brussels, COM(2004)472

European Environment Agency (2004) *Impacts of Europe's changing climate: an indicator based assessment*, Copenhagen: European Environment Agency.

European Environment Agency (2006) *Urban Sprawl in Europe: the ignored challenge*, EEA Report 10/2006, Copenhagen: European Environment Agency.

European Sustainable Cities & Towns Campaign (2003) *Thematic Strategy On The Urban Environment, Consultation Report of Local Authorities, Coordinators: Council of European Municipalities and Regions (CEMR) and EUROCITIES.* Brussels, ACRR, Climate Alliance, CEMR, Energie Cities, Eurocities, Healthy Cities, ICLEI, Medcities, UBC, UTO**:** 12.

European Union (2000) *Water Framework Directive*, 2000/60/EC.

European Union (2007) *Directive 2007/60/EC: on the assessment and Management of flood risks*. Online. Available HTTP: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:288:0027:0034:EN:PDF (accessed 25 May 2011).

Evans, E., Ashley, R., Hall, J., Penning-Rowsell, E., Saul, A., Sayers, P., Thorne, C. and Watkinson, A. (2004) *Foresight: Future Flooding. Scientific Summary: Volume 1, Future Risks and their Drivers,* London: Office of Science and Technology.

FIAC (2007). Flooding Issues Advisory Committee Final Report (4). Scottish Government.

Folke, C., Hahn, T., Olsson, P. and Norberg, J. (2005) "Adaptive Governance of Social-Ecological Systems." *Annual Review of Environment and Resources* 30 (1): 441-473.

Funtowicz, S. O. and Ravetz, J. R. (1991) 'A New Scientific Methodology for Global Environmental Issues.' 137-152. In Costanza, R. (ed.) *Ecological Economics: The Science and Management of Sustainability*, New York: Columbia University Press.

Funtowicz, S., and Ravetz, J. R. (1994). "The worth of a songbird: ecological economics as a post-normal science." *Ecological Economics* 10 (9): 197-207.

Godschalk, D. (2003) 'Urban Hazard Mitigation: Creating Resilient Cities', *Natural Hazards Review*, 4 (3): 136-43.

Gunderson, L., and Holling. C. (2002) *Panarchy: Understanding Transformations in Human and Natural Systems.* Washington, DC: Island Press.

Hansson, S.O. (2009) 'A Philosophical Perspective on Risk', in Lofstedt, R.E. and Boholm, A. (eds) *The Earthscan Reader on Risk*, London: Earthscan.

Heritier, A. (2002) The accommodation of diversity in European policy-making and its outcomes: regulatory policy as patchwork, in Jordan, A. (ed) Environmental Policy in the European Union: Actors, Institutions and Processes, Earthscan, London.

Holling, C.S. (1978) Adaptive Environmental Assessment and Management. Chichester: John Wiley and Sons.

Institution of Civil Engineers (2001) *Learning to live with Rivers*, London: Institution of Civil Engineers.

IPCC (2007) *Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Geneva: IPCC.

Ison, R. and Watson. D. (2007) "Illuminating the Possibilities for Social Learning in the Management of Scotland's Water." *Ecology and Society* 12 (1): 1-21.

Jordan, K. (2002) Environmental policy in the European Union: actors, institutions and processes, Earthscan, London.

Jordan, A. (2002) The politics of multilevel environmental governance: subsidiarity and environmental policy in the European Union, Environmental Planning A, 32: 1307-1324.

Klein, R.J.T., Nicholls R.J. and Thomalla F. (2004) 'Resilience to natural hazards: How useful is this concept?', *Environmental Hazards.* 5: 35–45.

Klijn, F., Samuels, P. and Van O. (2008) 'Towards flood risk management in the EU: State of affairs with examples from various European countries', *International Journal of River Basin Management,* 6: 4, 307-321.

Klijn, EH. (2008) Governance and governance networks in Europe, Public Management Review. 10(4): 505-525.

Knill, C. (1998) European policies: the impact of national administrative traditions on European policy making, Journal of Public Policy, 18(1): 1-28.

Knill, C and Lenschow, A. (2000) Implementing EU Environmental policy: New Directions, Old Problems, Manchester University press, Manchester.

Kollmuss, A, and Agyeman, J. (2002) “Mind the Gap: why do people act environmentally and what are the barriers to pro-environmental behavior?” *Environmental Education Research* 8 (3): 239-260.

Kreibich, H., Thieken, A. H., Petrow, T., Müller, M. and Merz, B. (2005) Flood loss reduction of private households due to building precautionary measures – lessons learned from the Elbe flood in August 2002. *Natural Hazards and Earth System Sciences.*

Majmudar, A. K. (2009) *The National Flood Insurance Program: Maintaining its Head Above Water*. University of Miami, International and Comparative Law Review.

March, J. and Olsen, J. (1989) *Rediscovering Institutions: The Organisational Basis of Politics*, Free Press, New York.

Marchand, D. and Salagnac, J. L. (2009) Capacity Building and Information Quality, in Pasche, E, Evelpidou, N, Zevenbergen, C, Ashley, R and Garvin, S. (eds). *Urban Flood Conference. Road Map Towards a Flood Resilient Urban Environment*. Urban flood management in cooperation with Unesco-IHP, Paris.

Ministry of Transport, Public Works and Water (2008) *National Water Plan 2009-2015*, The Hague, the Netherlands.

Ministry of Transport, Public Works and Water Management (2006) *Spatial Planning Key Decision ‘Room for the River’*. Online. Available HTTP: <http://www.ruimtevoorderivier.nl> (accessed 18 Apr 11).

Kolen, B. Maaskant, and F. Hoss, “Meerlaagsveiligheid : Zonder normen geen kans,” 2010, pp. 18-25.

Mostert, E., Pahl-Wostl, C., Rees, Y., Searle, B., Tabara, D. and Tippett, J. (2007) “Social learning in European river basin management; Barriers and fostering mechanisms from 10 river basins.” *Ecology and Society* 12 (1): article 19, 16 pages [online].

Mostert, E. Et al (2007) Social learning in European river-basin management: barriers and fostering mechanisms from 10 river basins, Ecology and Society, 12(1): 19.

Ostrom, E. (2009) “A General Framework for Analyzing Sustainability of Social-Ecological Systems.” *Science* 325 (5939) (July 24): 419-422.

Owens, P. and Owens, S. (1991) *The Environment, Resources and Conservation*, Cambridge University Press: Cambridge.

Pahl-Wostl, C. (2009) A conceptual framework for analysing adaptive capacity and multi-level learning processes in resource governance regimes, Global Environmental Change, 19(3): 354-365.

Pahl-Wostl, C., Mostert, E. and Tàbara. D. (2008) “The Growing Importance of Social Learning in Water Resources Management and Sustainability Science.” *Ecology and Society* 13 (1): 24.

Pall, P., Aina, T., Stone, D. A., Stott, P. A., Nozawa, T., Hilberts, A. G. J., Lohmann, D. and Allen, M. R (2011) Anthropogenic greenhouse gas contribution to flood risk in England and Wales in autumn 2000, *Nature,* (470), 382-385.

Petts, J. (2004) Barriers to Participation and Deliberation in Risk Decisions, evidence from waste management, *Journal of Risk Research*, 7 (2), pp. 115-133.

Pitt, M. (2007) *Learning Lessons from the 2007 Floods, an independent review by Sir Michael Pitt*, London: Cabinet Office.

Pridham, G. (2002) National environmental policy making in the European framework: Spain, Greece and Italy in Comparison, in Jordan, A. (ed) Environmental Policy in the European Union: Actors, Institutions and Processes, Earthscan, London.

Ravetz, J. R. (1997) “The science of `what-if?’.” *Futures* 29 (6): 533-539.

Ravetz, J. R. (2011) “Postnormal Science and the maturing of the structural contradictions of modern European science.” *Futures* 43 (2) (March): 142-148.

Ravetz, J. (2000). *City Region 2020, Integrated Planning for a Sustainable Environment*. London, Earthscan Publications.

Rehbach, J., Hinsberger, I. (2008), *Prospective Risk Management: A Review of German Legislation Targeting Integral Flood Management*, Working Paper No. 7/2008, Bonn: United Nations University

Reith, G. (2009) '*Uncertain Times: the notion of 'risk' and the development of modernity'*, in Lofstedt, R.E. and Boholm, A. (eds) *The Earthscan Reader on Risk*, London: Earthscan.

Rittel, H. and Webber, M. (1973) 'Dilemmas in a General Theory of Planning', *Policy Sciences*, 4, 155-169.

Rhodes, R. A. W. (2001) *Understanding Governance - Policy Networks, Governance, Reflexivity and Accountability*. Buckingham: Open University Press.

Robinson, S. (2004) *Institutional and Technical Barriers to the Investigation and Remediation of Contaminated Land*, Ph.D Thesis, School of Planning and Landscape, University of Manchester.

Rockstrom, J., Steffen, W., Noone, K., Persson, A., Chapin, F. S., Lambin, E. F., Lenton, T. M. (2009) "A safe operating space for humanity." *Nature* 461 (7263): 472-475.

Rogers, E.M. (2003) *Diffusion of Innovations* (5th Edition). New York: Free Press.

Rogers, E.M., Medina, U., Rivera, M. and Wiley, C. (2008) "Complex Adaptive Systems and the Diffusion of Innovations." *The Innovation Journal: The Public Sector Innovation Journal* 10 (3): Article 29, 1-26.

Sabatier, P. A. and Jenkins-Smith, H. C. (1999) The Advocacy Coalition Framework: An Assessment. In *Theories of the Policy Process,* 117-166. Boulder, Colorado: Westview Press.

Selman, P. (2000) *Environmental Planning*, Sage, London.

Shove, E. (2010) "Beyond the ABC: climate change policy and theories of social change." *Environment and Planning A* 42 (6): 1273 – 1285.

Stern, N. (2007) *The Economics of Climate Change: the Stern Review*, Cambridge: Cambridge University Press.

Sterner, T. and Turnheim. B. (2009) “Innovation and diffusion of environmental technology: Industrial NOx abatement in Sweden under refunded emission payments.” *Ecological Economics* 68 (12) (October 15): 2996-3006.

Taylor, M. (2000) 'Communities in the Lead: Power, Organisational Capacity and Social Capital' (a consideration of the move towards community leadership) in *Urban Studies* 37(5-6) 1019-1035

Tielrooij, F. (2000) *Anders omgaan met water, waterbeleid voor de 21e eeuw (Dealing differently with water, Water policy for the 21st century),* Den Haag, the Netherlands.

Tibaijuka, A. (2009*) ‘Statement of the Executive Director of UN-HABITAT, Mrs. Anna Tibaijuka on the occasion of the 25th Meeting of the UNEP Governing Council’*, Nairobi, Kenya, 17 Feb. Online. Available HTTP: <http://www.unhabitat.org/content.asp?cid=6221&catid=14&typeid=8&subMenuId=0. (accessed 18 Apr 11).

Tippett J., Griffiths E,J. (2007) New approaches to flood risk management – implications for capacity building, in *Advances in Urban Flood Management,* edited by A. Vassilopoulod, R. Ashley, C. Zevenbergen, E. Pasche, and S. Garvin. Taylor & Francis.

Tippett, J., Searle, B., Pahl-Wostl, C. and Rees, Y (2005) “Social learning in public participation in river basin management—early findings from HarmoniCOP European case studies.” *Environmental Science and Policy* 8 (287-299).

Tourbier, J.T., and Ashley R. M. (2007) *Integrative Teaching and Learning Modules for the Application of On-Site Urban Flood Resilience Planning*, Aquaterra Conference, Amsterdam, pp 85-102.

Trudgill, S. T. (1990) *Barriers to a better environment: what stops us solving environmental problems*, Belhaven Press, London.

United States Environmental Protection Agency (2000) *An Analysis of Barriers to Innovative Treatment Technology: Summary of Existing Studies and Current Initiatives*, Cincinnati, USA.

Versluis, E. (2004) Explaining variations in implementation of EU Directives, European Integration Online Papers, (8): 19.

Vigar, G. (1997) Implementing a new ‘realism’ in transport planning, *Town and Country Planning*, June, pp. 182-184.

Vigar, G. (2000) Local Barriers to Environmentally Sustainable Transport Planning, *Local Environment*, 5 (1), pp. 21-34.

Watts, K. and Selman, P. (2004) Forging the pace of biodiversity action: a force field analysis of conservation effort at the 'landscape scale'*, Local Environment,* February, pp. 5-20.

White, I. (2005) *Barriers to Effective Environmental Planning: the Case of Sustainable Drainage Utilisation within the Planning System in England*, Ph.D Thesis, School of Planning and Landscape, University of Manchester.

White, I. (2010) *Water and the City: Risk, Resilience and Planning for a Sustainable Future*, Routledge: London.

White, I., Kingston, R. and Barker, A. (2009) 'Participatory GIS for Developing Flood Risk Management Policy Options', *Journal of Flood Risk Management* (In press).
White, I. and Richards, J. (2007) 'Planning Policy and Flood Risk: The Translation of National Guidance into Local Policy', *Planning, Practice and Research*, 22 (4): 513-34.

Wilkinson, D. (2002) Maastricht and the environment: the implications for the ECs environment policy of the treaty of the European Union, in Jordan, A. (ed) Environmental Policy in the European Union: Actors, Institutions and Processes, Earthscan, London.

Wilson, E. O. (1998). *Consillience, The Unity of Knowledge*. New York, Alfred A. Knopf.

Wisner, B., Blaikie, P., Cannon, T. and Davis, I. (2004) At Risk: Natural hazards, people's vulnerability and disasters, London: Routledge.

World Water Council (2000) *World Water Vision Commission Report: A Water Secure World, Vision for Water, Life and the Environment*, Counseil Mondial de l'Eau: 70

Wynne, B. (2009) 'Uncertainty and Environmental Learning: Reconceiving Science and Policy in the Preventative Paradigm', in Lofstedt, R.E. and Boholm, A. (eds) *The Earthscan Reader on Risk*, London: Earthscan.

Zevenbergen, C., Cashman, A., Evelpidou, N., Pasche, E., Garvin, S. and Ashley, R. (2010) *Urban Flood Management*, Taylor and Francis: Oxford.

PART 3 - NATIONAL REVIEWS SUMMARY

Notes:
This table is a synthesis of the National Reviews of the countries represented by SMARTeST partners. It is designed to aid comparisons and analysis. It comprises the most important points within each individual section of the reviews although some original responses have been transferred to more appropriate sections. National Review authors have, where necessary, verified the entries for their country.

Question	United Kingdom	Germany	France	Netherlands	Spain	Cyprus	Greece
1.1 Agencies and bodies with responsibility for flood risk management/ prevention	Responsibility for flood risk management in England and Wales is divided between the EA ('national level' flood risk - i.e. main river, sea and reservoir flooding) and unitary and county authorities (all other sources of flooding). Local Authorities (LAs) interact with the utility companies, the Highways Agency, Internal Drainage Boards and riparian land-owners in the delivery of regional and sub-regional/local FRM. Ultimately it is the owners of property/ land who have the primary responsibility for managing flood	The 2005 "Act to Improve Preventive Flood Control", gives state agencies the mandate to revise State water laws and to implement flood defence strategy covering land use, flood preparedness, stakeholder capacity building and contingency planning. Transfer of the 2007 EU Flood Directive into state laws was accomplished through the 2007 Federal Building Code, the 2007 Federal Regional Planning Act and the 2009 Federal Water Resources Act. **Facilitate uptake:**	The Environment Ministry is the main initiator of the regulations regarding flood prevention/protection. Environment and Energy Regional Direction (DRIEE) coordinates the actions, at a departmental' scale regarding flood risk management. Departmental Public Works Directorate (DDT) is the department responsible for assessing natural hazards and risk prevention plan drafting and for defining area where the building is permitted and not permitted. The Regional Council (CRIF) isn't officially in	National government r.e. main rivers. Regional water boards r.e. small rivers, polders and canals. Municipalities r.e. sewer system, stormwater and groundwater (+land use planning). Flood prevention is the main governmental policy. The National Water Plan (2010) distinguishes between three 'layers of safety': 1) prevention, 2) durable spatial planning and 3) emergency management. **Facilitate uptake:** Space limitations help to open way	Spain is a decentralized country, where the regions (called Autonomous Communities) have the responsibility on the land management, civil protection and environment. At the national level, the State has only responsibility for coordination, support and water management in the interregional basin districts. There are two main coordination systems, the National Civil Protection Commission, where the State and the Autonomous Communities coordinate	The Water Development Department (WDD) of the Ministry of Agriculture, Natural Resources and the Environment has recently been appointed by Law as responsible public body for the compliance with the Floods Directive. There are no regulations yet listing responsibilities of the WDD and the ongoing practice regarding flood risk management/ prevention is still fragmented. There are many agencies and bodies which have overlapping/ conflicting/ inconsistent jurisdictions with no	Regional Department of Water in cooperation with the Directorate of Civil Protection develop management plans for flood risk, including flood forecasting and early warning systems, with emphasis on prevention, protection and preparedness. The Ministry of Environment, Energy and Climate Change may undertake the preliminary flood risk assessment, the flood hazard maps and FRM plans at the request of the Region . The Forest Service is responsible for flood

	risk associated with their assets. **Facilitate uptake:** The elected members of the Regional Flood Committees can agree a local levy paid by County and Unitary authorities to fund works which do not attract a sufficiently high priority by national government but which are nonetheless cost effective and of local importance. United Utilities Business Plan 2010-2015 states that their investment programme will feature a major expansion in protecting properties at risk of flooding The Government is consulting on how to give Surface Water Management Plans a stronger role in coordinating development and investment planning.	The 2007 EU Flood Directive strengthens concepts laid out by the 2005 "Act to Improve Precautionary Flood Control and provides the basis for the uptake of Fre. It requires flood protection in land use plans and transfers floodplain alignments from regional to municipal level. DWA, a professional NGO has developed a voluntary audit that permits an evaluation of state- and municipal plans concerning uptake of Fre techniques. **Hinder uptake:** Emphasis remains to lie on actions by state government Most of the general public remains convinced that flood defence and compensation for flood losses are an obligation of Government. This is	charge of flood management but it acts by financial means. County councils are in charge of land planning e.g. management and the sustainment of the transports, roads and rivers (competence shared with the Regional Council and the municipalities). Municipality Mayors are responsible for public safety including flood risk planning. **Facilitate uptake:** Environment Ministry promotes FRe in areas where construction is forbidden. DRIEE communicate state policy. DDT know local conditions and stakeholders. County Councils in contact with local inhabitants and active in flood protection. Water Authorities have financial clout. Municipal mayors are sensitive to local needs including	for smart solutions instead of applying traditional engineering solutions. Interest varies between cities: some cities, especially large cities like Rotterdam and Amsterdam are actively seeking application of smart solutions like floating buildings. **Hinder uptake:** Focus on large structures limits energy put into smart technologies. It is not entirely clear who is financially responsible for compensating the hazard impacts. Traditional culture of water boards leads to limited interest in smart technologies; Strong role of Government limits interest of individual home owners (citizens) in applying flood	plans and responsibilities for Civil Protection, and the National Water Council, which represents all interests in water and rivers. Thus, for river management, central Government manages the hydrological Information system, produces flood risk maps and coordinates operations. Autonomous Communities report on environmental issues and advise the state and local authorities are responsible for FRM. Local Authorities are responsible for rivers in urban areas as well as local development plans and civil protection in urban areas. It is necessary to distinguish Central Responsibilities from Regional	overall coordination. This gap will hopefully be shortly resolved with the WDD, which has the expertise and the capabilities, taking over the co-ordinating role. This new law should facilitate the application of SUDS and FRe but will not have powers to apply FRe re coastal flooding. Not all urban areas have drainage boards (Nicosia, the largest and capital city does not have a Public Utility for storm water drainage. Planners will have real power to influence development and the application of FRe although they lack expertise on FRe.	protection project planning in public woodlands. Municipalities have no substantial participation to flood management. **Facilitate uptake:** Municipalities, Inter-municipal bodies and Forestry service suggest FRe measures to be financed and implemented by either the Region or the Ministry of Environment, Energy & Climate Change. **Hinder uptake**: Management plans have either been undertaken in some cases of river basins or will be by December 22, 2015 thus providing a wide timeframe which will not promote immediate FRe uptake. Bureaucracy and lack of appropriate funding.

	The Government sees local authorities in a leadership role with the EA advising / quality-assuring the plans. (Future Water p.58). (*Comment: This could also hinder uptake due to cutbacks to LA budgets).* **Hinder uptake:** The EA is not directly responsible for surface water flooding (which is the responsibility of the Local Authority and the water utility company). This split responsibility is a potential barrier to integrated flood risk management in urban environments. Despite earlier promises to the contrary, FRM will not escape cutbacks. The new Coalition Government have cut flood-defence spending by 8% annually from 2011.	the case, even though Art. 1a, sec.2, obligates private persons to use Fre practices to avoid flood losses Most municipal decision-makers still see structural flood defence measures as an answer to more frequent and periodic flooding experienced over the last decades. Extensive Government aid encouraged redevelopment of damaged properties without FRe improvements.	economic development and not compromising property values. Public Associations and NGOs are active lobbyists. In the Seine/Paris region IIBRBS, a joint organisation between four departments in charge of the vulnerability master plan might diffuse the use of FRe **Hinder uptake:** Environment Ministry's territorial planning procedure is slow and does not cover all areas. DRIEE is hindered by administrative procedures. DDT hindered by lack of expertise and FRM is low priority in comparison with techno/industrial risks. CRIF's role is unclear and it fails to develop a robust FRM policy. The municipal mayor mandate lasts only 6 years; municipalities prefer to protect against a ten or 20	protection measures.	Responsibilities- the contrary would collide against Spain's political pillars. There is no hierarchical links between those two (independent/autonomous) administrative levels. Current general tendency is to maximize the transfer of responsibilities from the Central Government to the Regions, in accordance with the strict constitutional core of responsibilities *state-owned.*		

	In Scotland, the 2009 Flood Risk Management (Scotland) Act transposes the EC Floods Directive into national law and places a duty on the Scottish Government, SEPA, Scottish Water and local authorities to better co-ordinate the assessment and management of all types of flood risk. Local authorities are required to prepare local flood risk management plans.		year flood rather than a 100 year flood. IIBRBS promotes improved storage capacity rather than FRe.				
1*.2.1 Recent administrative changes** ***Over the past 15 years	Shift from 'flood defence' to 'flood risk management'. The emergence of surface water as the major source of flooding in the UK has challenged the 'hard defences' approach and flooding as being the remit of just one agency. Limited institutional coordination/	Since 2000 the German advisory council on the environment has been advocating more retention areas for rivers. 2005 "Act to Improve Preventive Flood Control", reflecting a concept of flood resilience with land use control, flood preparedness,	The decentralization Law, some of the state missions have been transferred to the regional or to the county councils.	In 2004, water as a 'guiding principle' was introduced in the Spatial Planning Act (2004). In 2008 the new Delta committee reported on the protection of the coastal zones and the inner dike areas for the next 200 years, triggered by climate change. The National Water	Transfer of responsibility to the Autonomous Regions of water resource management, civil defence and spatial planning.	The most notable change was the accession of Cyprus to the European Union and thus implementation of EU directives which have led to the establishment of the WDD and drainage boards in urban areas.	From January 2011 a reallocation of powers and responsibilities towards new larger Municipalities and decentralized Regions. Also split of relevant ministry into Ministry of Environment, Energy and Climate Change and Ministry of Infrastructure, Transport and

	administrative fragmentation means management is achieved through partnerships. Increased reliance upon the 'market' and private contractors for the delivery of most collective/ public services – even those funded by the state. There is a lack of consistency in the approach and the attitude of different EA offices and officers.	capacity building of stakeholders and contingency planning, breaking with traditional emphasis on structural flood defence. Capacity building of stakeholders, increasing public awareness of risks . Risk precaution is being offered by the insurance industry through complementary flood risk coverage. This is not mandatory and premiums are influenced by a zone system of flood inundation (ZÜRS) developed by the insurance industry.		Law prescribes that water is used in spatial planning, and stored locally. For example, municipalities should take in to account water management issues in their spatial planning, including adequate urban drainage structures to prevent pluvial flooding and groundwater flooding.			Networks.
1.2.2 Recent administrative changes ***How responsibility for FRe uptake been affected by these developments***	Despite water companies being profit orientated, greater emphasis on private sector to take responsibility for FRM is seen by some FRe systems/products manufacturers as an opportunity for sales and may facilitate	Responses in regard to the uptake of technologies and products have been slow. Technologies and products need to be privately financed. The public and their municipal representatives	Positive because of the increasing number of competent stakeholders and, due to the decentralization process, the regional and county councils have become sources of information or incentives for the uptake of FRe.	Strict preventive standards gives opportunities for resilience measures. Water boards are evaluating their regional flood protection structures and this	No relevant changes	FRe systems will fall under the responsibility of the WDD for flood risk management/ living with the floods. WDD is not yet in full control of flood risk management.	Relevant processes and procedures are now more time consuming.

	uptake. Retreat of 'the state' in flood risk management in some areas promotes (or perhaps forced?) household/ individual/ community uptake of FRe. In Northern Ireland, the Rivers Agency will change its role from flood defence to flood risk management, encompassing not only the present duty to minimise the risk to people, property and the environment, but also other challenges associated with development and climate change. This will necessitate a closer working relationship with other Government departments.	would like to see government funding. Transfer of flood preparedness into standards and codes is in its infancy.	Moreover, the emergence of public organisations (resulting from grouping of local authorities), such as IBRBS, or the numerous river associations, may impact positively Fre uptake. However local technical services may be more accountable to elected representatives which could compromise uptake of FRe.	may trigger the uptake in areas where space for application of large structures is lacking. The new National Water Law explicitly lays responsibility for pluvial and groundwater flooding with local governments (cities). Cities apply similar standards for flooding: maximum flood frequencies of once per year or per two years but the reason for application of relatively low protection standards is that damage remains limited because flood depths in flat areas are limited. Most homeowners seek private insurance for pluvial and groundwater flooding.			
1.3.1 Future	The abolition of	Implementation of	Difficult to predict	A so-called Delta	No major	Allocation of	Staff transfers from

developments ***Please detail any planned changes to this administrative structure, and the reasons for these.***	regional bodies could adversely affect 'regional' FRM but this might be off-set by increased relevance of the Flood/water Framework Directives. It is likely that land ownership will be further fragmented by land sales on the part of that state thus compromising comprehensive river catchment management strategies. There is a lack of joined up thinking between different government departments and agencies.	the EU Flood Directive and the resulting flood risks management plans by the states will contribute to a change in public perception of FRe's over time.	whether the decentralisation process will go ahead or if the central state will go on playing a key role in the new management processes (especially in the Greater Paris/strategic areas). There is an emerging consensus concerning the idea of constructing in flooding areas	Committee was installed to investigate current flood protection in the Netherlands at the national level (coastal and river flooding) and to develop an updated Delta Plan and Delta Law taking into account future developments in population, economy and climate but it is not expected to change the current division of responsibilities for flood protection.	administrative changes expected, however EU Flood Directive's calling for an improved coordination between the different Public Authorities and enhanced public implication in the flood risk management will challenge traditional ways of working.	responsibility to the WDD for flood risk management under the Floods Directive.	one service to another will result in redistribution of responsibilities.
1.3.2 Future developments ***Identify how future developments to administrative structures may impact upon the uptake of FRe systems, technologies and products.***	Likely to be less public funding for future FRM. Changes to administration and insurance arrangements may stimulate individuals, communities and civil society organisations to adopt FRe.	Implementation of the EU Flood Directive and of the EU Water Framework Directive will encourage 'green' FRe techniques and SUDS, such as Surface conveyance of storm water (exceedance pathways) and	New collaborations could prefigure an interesting negotiation between the central State and the other stakeholders in the context of the Flood Directive. The increasing real estate demand put pressure on the central state to liberalise the construction in	No future developments to administrative structures are foreseen. The position of Water Boards as the oldest governmental structure in the Netherlands (since the Middle Ages) is quite stable.	No major administrative changes are envisaged	The future role of the WDD will produce a co-ordinated approach to water management including flood risk management. Already, the WDD is promoting the re-use of storm water at its source/ water harvesting. It is also	From July 7, 2011 the responsibility of road and hydraulic works will be passing from the Ministries to the Decentralized Regions' Management Control of Construction Works. The wide timeframe of implementation of

		related flood proofing. They constitute public works that are already commissioned by the states and have won public acceptance in Germany. More of these techniques can be expected in future developments.	flooding areas and greater exposure of populations to risk could be a real opportunity for Fre uptake.			promoting SUDS	National legislation and the EU Floods Directive hinders the uptake of FRe technologies and products. Red line and lack of organization in the newly established local authorities create additional obstacles.
1.3.3 Future developments ***What kind of new citizen responsibilities are being developed?***	The state has fewer resources - and the Government a decreasing desire - to provide flood protection. The Coalition Government has promoted the idea of 'the Big Society' - might place greater onus upon property owners to defend themselves using small-scale FRe technologies. ABI's threat to revoke Statement of Principles (see 1.9) may mean individuals and entire communities are		Difficult to say that the Flood Directive will lead to participative procedures. Every planning project has to including a public enquiry. However, there is almost no participant in 99% of these public enquiries.	Home owners have become explicitly responsible for protection from groundwater flooding. Home owners are also expected to manage pluvial waters on their property. The new responsibility of home owners for stormwater storage is likely to trigger the uptake of rainwater harvesting and stormwater storage and infiltration facilities. It is not clear how and	High importance to enhance the civic awareness about natural risks, e.g. capacity building.	Flood risk maps will be prepared at some stage. Citizens will then be informed of their risks and will be responsible to take measures to live with these risks.	Citizens act on a voluntary basis with regard to environmental issues and protection. In the context of flood risk citizens tend to place sand bags in sensitive areas. Regional Department of Water ensure the active participation of stakeholders in drafting, reviewing and updating plans for flood risk management.

	unable to insure their property against flood.			whether this will influence the uptake of flood protection technology.			
1.4.1 Responsibilities of spatial planners and the planning system ***What is the formal role of spatial planners and 'the planning system' (at all spatial scales appropriate) in terms of managing flood risk?***	Aim of planning policy is to ensure that risk is taken into account at all stages of the planning process and planners can place conditions when granting approval re drainage. But in practice, this is negotiated between utility companies and developers. Planners do not know much about FRe – e.g. options or performance. This is a key reason for the project.	Sites for flood retention basins are reserved and flood plains kept as natural retention areas. At the city planning scale flood protection is a public concern. This includes Fre.	Distinction between spatial planners according to the scales. At a local scale, the mayor produces an urban planning master plan. Post 1995 risk prevention regulations introduce zoning areas where development is permitted or refused At the river scale, water management master plans covering watersheds are implemented. Regulations on stormwater management in urban master plans differ considerably from one municipality to another.	National Governmental Agreement on Water (2008): states that spatial planners and water authorities should cooperate in the establishment of spatial development plans. Every spatial development plan must include a so-called water paragraph that describes the impacts of spatial development on the water system, how potential negative impacts are mitigated and how the spatial development improves the water situation. For instance, the water paragraph usually indicates how much space is allocated for water storage in the spatial	According to the Land Use Act ("*Ley del Suelo*") and the National Hydrological Plan, areas prone to flood risks are classified as unsuitable for development. Hydrographic Public Bodies also elaborate planning reports seeking to prevent the development of zones at flood risk and this filters down to local level. All land which is not classified as developed or suitable to be developed should be seen as not ready for development, thereby implying that 'generic' protection does exist over all land subject to flood risks	The Department of Town Planning and Housing of the Ministry of Interior of the Republic of Cyprus is staffed with highly qualified personnel. A major planning policy is to ensure that risk is taken into account at all stages in the planning process, and preparing Regional Flood Risk Appraisals (RFRAs) or Strategic Flood Risk Assessments (SFRAs). Planners can place conditions on planning approval with regard to drainage (and also now SUDS).	On a local level, any planning activities are forced to take into consideration streams and river beds of an area. On a national level and in the context of management plans and flood risk, both the Regions and the Ministry are obliged by law to involve spatial planners

				development plan. Water authorities must be consulted.			
1.4.2 Responsibilities of spatial planners and the planning system ***What is the role of planners and 'the planning system' for influencing the uptake of FRe systems and technology?***	Only marginal. Planners only have influence over new developments/ re-development – yet much risk is already embedded, requiring retro-fitting.	Flood Risk Management plans that include FRe are the core of the EU Flood Directive (2007) . Decisions concerning the type of measures to be used to flood-proof structures lie with the property owner.	Local or state authorities display information or organise communication campaigns.	Flood prevention is the main governmental policy. The national government is developing together with municipalities and water boards a methodology for risk-zoning of vulnerable areas. Providing durable spatial planning solutions gives opportunities for spatial planners.	No statutory role but consultations during the planning process may allow planners to inform about FR systems and technology that might render an area of land safer and, thence, apt for development	Marginal. Planners only have influence over new developments/ re-development – yet much risk is already embedded, require retro-fitting.	The new relevant Joint Ministerial Decision and the European Legislation, the environmental assessment of each project is compulsory , thus the implementation of FRe technology could be ideally promoted.
1.4.3 Responsibilities of spatial planners and the planning system ***What should be the role of planners and 'the planning system' for influencing the awareness of flood risk and adapted behaviours to cope with***	The widening of the UK planning system to account for broader spatial functions provides significant opportunity for increased dialogue and awareness raising within decision making. Government has also recommended that the spatial planning system and planners assume a greater role in managing	EU Directives see stakeholder identification and stakeholder participation as a component of the planning process. It has been recommended to formulate learning coalitions of stakeholders to facilitate implementation of flood risk management planning, placing	Planners should follow, on the long range (term). For instance they could generalise water marks, informing the people on the relevant behaviours in case of flood.	Integration of water management and urban planning is crucial, as is negotiation and designing for different stakeholders in spatial planning	Stronger policies in order to mitigate vulnerability should be undertaken, especially in those areas at flood risk pointed out by the Flood Directive. Also, more public awareness and stakeholder consultation is required.		Make sure that all relevant legislation is truly enforced. Monitoring of and reporting on human activities in river beds. Informing citizens and agencies and raising awareness via the organization of informative events, advertising campaigns both in Greece and abroad

flood?	flood risk. Liaising with developers over effective site selection and design could enhance the environmental dimension of Corporate Social Responsibility. Specialist awareness of environmental risk within the planning system is, however, an impediment.	the planner into the role of mediator.					in order to ensure the people's active participation in the area development plan
1.4.4 Responsibilities of spatial planners and the planning system ***What are the steps and procedures in the planning process and what alterations should be made?***	Broadly the planning system could ensure that if development must go ahead in an 'at risk' area, much stronger and detailed building regulations should be insisted upon. More comprehensive assessments and plans to manage risk would also be useful.	Flood control in the past has been the privileged domain of civil engineers. The EU Flood Directive (2007) requires an interdisciplinary approach, which will be a change from current practice. It also calls for a cost-benefit evaluation of measures which may become a political obstacle	Planners follow a prescribed "step" procedure.	Cooperation between stakeholders at several levels (horizontally as well as vertically) is being promoted and intensified as a result; this is an ongoing process.	The Land Use Act should define accurately the flood area extension, and tie such areas to a specific return period. Buildings in areas subsequently classified as unsuitable for development are invariably demolished when they could feasibly be protected against flood.	Broadly the planning system could ensure that if development must go ahead in an 'at risk' area, much stronger and detailed building regulations should be insisted upon.	
1.4.5 Responsibilities of spatial planners and the planning system ***What role do***	To a certain extent, UK provisions for strategic environmental assessment (SEA) provide a partial decision support	Today, with the help of IT, there are unparalleled opportunities for information and communication. Computer assisted	There is considerable interest for a decision support tool re damage assessment to promote vulnerability reduction by several	The usefulness of decision support tools in practice is limited in their actual support of decisions. In this process,	The Directive 2007/60/CE should be complemented with the implementation of flood risk management plans	If development must go ahead in an 'at risk' area, much stronger and detailed building regulations and comprehensive	A very important one especially if decision support systems can be localized and lead to a better understanding of the

you see for the use of decision support systems?	system for strategic planning.	planning and education aids should be targeted at the needs of different stakeholder groups	stakeholders in the planning process.	decision support tools are rarely used, probably because the decision process is too diffuse and involves too many steps to identify decisions where the tools would be useful.		assessments should be insisted upon.	area,
1.4.6 Responsibilities of spatial planners and the planning system ***What are the barriers/ resistance to an increased role for planners in facilitating FRe uptake?***	Lack of ability to retro-fit – particularly at a site level. The profession is generalist and tends to be ill-informed about risk and FRM. FRe is not a core component of a planner's education and few have specialist expertise. Flood risk is seen as sitting outside the planning system. Even in instances where FRe is conditional for granting permission, their enforcement prior to hand-over of sites and their maintenance by subsequent building users, is difficult or even impossible to effectively enforce.		In Paris area, is the negation (denial) of the possible major flood (such as the one which occurred in 1910) by the population and even by some planners.	Lack of knowledge of available options is probably the most important barrier.	Citizens should hear from planners the idea that flood risk is an inevitable hazard requiring a specific preparation to cope. There is a delicate balance between National, Regional and Local administrations and any change in status will be difficult to enact.	Ill-informed; lack of ability to retrofit; flood risk is seen as being outside of the planning system; vested interest in ignoring risk due to political pressure to facilitate development.	Lack of initiative. Budgetary limitations. Responsibility limitations. Red tape.

1.5.1 Changes in the role of planners and planning ***Flood risk management?***	Government intends to 'roll back' the planning system and regulation on development e.g. relaxing of regulations on in-fill development and on covering of gardens. Whilst such changes may lead to increased ownership over local FRe issues, the Royal Town Planning Institute and others have expressed concern that a limited capacity for large scale spatial visioning will be detrimental to all aspects of environmental management.	Flood risk management is offering a great opportunity for the planner and the planning discipline, because it is intimately related to spatial planning, land use, and urban design.	The Water Agency is now responsible implementing the "new" flood prevention policy (Plan d'Action et de Prévention des Inondations and Plans de Gestion des Risques d'Inondations), more explicitly oriented towards the improvement of the vulnerability reduction of an area.	No changes are foreseen in the near future.	Planners are concerned with special flood protection plans, emergency plans, educational campaigns and land classification.		Planners' active participation in the National Program of Flood risk Management which will be undertaken by Regions and the Ministry of Environment, Energy & Climate change will increase their responsibilities in harmonizing the Greek Legislation with the EU Floods Directive.
1.5.2 Changes in the role of planners and planning ***FRe system and technology uptake?***	Not aware of any changes	There is a general deficit in the uptake of Fre systems and technology.	None	No changes are foreseen in the near future.	Implementing SUDS. and FRe ramps at garage's entrances. Despite not being legally enforceable, planners use their installation as a precondition to granting permits.	Not aware of planned changes	Cost of initiating FRe is generally too large for small bodies such as Inter-municipal and environmental agencies.
1.5.3 Changes in the role of planners and planning	Localism Bill will potentially increase the need for local authorities to deliver		There is a concern for this issue of multiple uses essentially in the flood prone areas.	As concepts become available, spatial planners start to introduce	See 1.5B above re garage ramps		

The support of FRe that has dual or multiple uses? (Often in an attempt to make them more acceptable to the public/ stakeholders).	outcomes which meet with significant levels of local support. On this basis, it is conceivable that FRe mechanisms will need to be promoted in such a way that they are seen to deliver multiple gains for local communities.		The main question is how to involve the farmers in the development of such areas.	these in their spatial development plan, where relevant. This is usually a result of close cooperation between local authorities (City Council), water authorities and spatial planners.			
1.6.1 Assessing the impact of the EU Floods Directive ***How have statutory agencies and administrative arrangements been affected by the EU Floods Directive, a) for flood risk management; and b) in terms of FRe systems, technology and products? Please consider policy, legislative, and regulatory issues.***	The EA and lead local authorities must now create preliminary flood risk reports and maps and flood risk management plans. These plans must include measures relating to prevention and protection. Assumption is that better risk assessment increases uptake of FRe features.	A) Good- thanks to preparatory work but implementation of measures will be hampered by the political difficulty of justifying upstream expenditures for the benefits for downstream users. B. Requirements of the Directive are being fulfilled but there is no requirement to audit them, thus no guarantee that FRe systems/ technologies will be implemented.	A) Incorporation into French legislation was only in July 2010- thus too soon to assess.	The overall approach to the EU Floods Directive in the Netherlands tends to be to try and incorporate it into existing law and regulations. There is a tendency to minimize changes to existing legislation and few changes in flood risk management are expected as a result of the EU Floods Directive	The Flood Directive offers an opportunity to develop an integrated FRM framework.		Agencies adhere to the standards as established by the National legislation and Directives of the European Union.
1.6.2 Assessing the impact of	UK Euro-scepticism. The Coalition	A change in philosophy from site	The Directive has been positively	The EU Floods Directive has	No political resistance	Neutral response	Although the Greek legislation does not

the EU Floods Directive ***Please review the political response to the Directive – has it been positively or negatively received? We are particularly interested in evidence of resistance to the Directive, or where barriers to its uptake have been identified.***	Government's *Programme for Government* said that it would "examine the case for a United Kingdom sovereignty legislation to make it clear that the ultimate authority remains with Parliament". The Bill is currently making its way through Parliament.	orientated flood defence to systematic risk management has been accepted on the federal and state levels and is being seen as an opportunity for innovation. However concerns were raised about the bottom-up approach for the involvement of stakeholders in a planning process where the result is open and that not truly affected stakeholders will pursue vested interests.	received by the central administration, the water agencies, and local elected representatives. It looks like almost all concern stakeholders appreciate the opportunity to integrate more flexibility in the existing regulations.	received limited political attention so far.	encountered. Negative reception due to bureaucratic process. Positive reception because the Directive represents a powerful opportunity to harmonise flood management at a national scale,		harmonize with the European legislation, the relevant Ministries work to implement the Directive by activating a National FRM Program. In that context the FRe technology uptake is not compulsory but it is always taken into consideration (especially when funding is available).
1.7.1 Communication of flood risk ***How is flood risk communicated to agencies with responsibilities for FRM and public protection?***	By the Environment Agency who identify both areas at risk, and issue flood warnings if an inundation is imminent. LAs, where there is a risk of flooding, should undertake Strategic Flood Risk Assessments (SFRAs)	Guidelines, papers, internet and by NGOs	Information on flood risk is communicated by the way of investigating committee report or professional guides. There are websites were the risk is mapped.	Most water authorities have websites that include information on flooding and flood protection and brochures for the general public that are distributed at their offices.	Some web applications have been developed (see 1.7B). Civil defence emergency plans	WDD	The Regional Department of Water ensures the active participation of stakeholders in drafting, reviewing and updating plans for flood risk management.
1.7.2 Communication	Internet, press, weather forecasts,	Pamphlets, Internet, Flood height	Guides or documents are designed and	A national flood risk map has been	Web sites: www.marm.es	Press, weather forecasts,	It is a Municipal responsibility, rarely

of flood risk ***How is flood risk communicated to the general public?***	warning signs	markers.	diffused by the municipalities. Flood areas atlases are drawn up to inform the general public about flood risk. Importantly the buyer of a property is informed by the seller on the natural hazards concerning the dwelling.	developed and there is a website where home owners can look up the flood risk level of their property.	http://sig.marm.es/snczi/visor.html http://www.112cv.com/ilive/srv. (Valencia) Emergency phone numbers and public information campaigns.	personal memory of past local flood events.	does it happen to be implemented as such. Citizens' awareness is considered to be very little. The media contribute partially.
1.7.3 Communication of flood risk ***How is flood risk communicated to specific neighbourhoods / communities considered under imminent threat from flooding?***	See B above + EA Floodline Warnings Direct: a free service that provides flood warnings by phone, text or email. However, Floodline only covers areas recognised by the EA to be at risk of flooding - excluding nearly all pluvial flooding. Local authority emergency planners and emergency services.	The work of state agencies	Public inquiries to inform the community. Neighbourhood meetings. The Environment and Energy Regional Direction tries to develop high water marks. National large-scale bi-daily flood vigilance map and hydrometeorologial vigilance maps to compliment more detailed local warning. Mayors have local responsibility.	As far as we know this is not the case.	Still to be addressed, awaiting flood risk maps. LAs are responsible for public warnings.	No forecasts or warnings yet. Floods are mostly flash floods and coastal floods.	In affected areas, there is more communication due to citizens' prior awareness based on previous events. Affected areas form local bodies to promote a safer environment.

1.7.4 Communication of flood risk ***What innovative/ smart methods to warn local people and to communicate flood risks are being considered or are being developed in your country?***	Reverse 999 calls to mobiles. However, Governmental concerns about freedom of information mean that it can only be used when people register their desire to be included on an existing warning list and the only flood risk warning list in operation is the EA's Floodline.	A web-page can provide up- to- the-minute flood warning and forecasting. Two examples in Germany are the Internet homepage of the Flood-Forecasting Centre (Hochwsser-Vorhersage-Zentrale HVZ) Baden-Würtenberg and the Flood-Warning Centre (Hochwassermeldez entrum HMZ) Rhine	Some River associations also have developed a warning system, which calls people when the river is reaching a worrying level. This procedure is only efficient when the floods aren't "flash floods".	Most water authorities have a contract with a commercial weather prediction agency that provides customised weather predictions for the relevant regions. Research has started recently on the development of local weather radars in urban areas that provide customised weather information (inc. rainfall) for urban areas at a much finer spatial scale.	So far, they have not been implemented as a general practice at the national scale At local scale telephone warnings, sirens and meteorological risks via web warnings	None yet.	New research now re storm forecasting/ monitoring based on automated telemetry precipitation/runoff stations.
1.8.1 Flood Risk Assessment and Maps ***What organisation has statutory/ legal responsibility for assessing flood risk and what is the extent of these responsibilities ?***	Environment Agency has an overview of the management of flood and coastal erosion risks in England. A key part of this role is to produce national strategies that will need to be followed. Unitary and county councils have local leadership in managing local flood risks. They must	States, to 100 year frequency. Saxony is dividing risk areas into 4 categories (serious, medium, minor, residual) and categories are considering water level, velocity and probability of occurrence.	Departmental Public Works Directorate with the help a consultancy. DRIEE maps the risk at the region scale. Some grouping of local authorities developed also their own modeling.	The national Government, the Provinces and water boards. New maps due in 2011 show the expected damage in case of flooding. The flood probabilities are based on the current situation.	Hydrographical Public Bodies share responsibilities with Municipalities, Autonomous Regions and Civil Defence Organisations. The Ministry of the Environment is developing a toolbox for a national cartographic system.	WDD	Based on the EU Floods Directive, the Regional Department of Water in cooperation with the Directorate of Civil Protection for flood risk maps.

	produce local strategies.						
1.8.2 Flood Risk Assessment and Maps ***Briefly describe the steps taken to map risk. For instance, what data is used to make assessments and how are these interpreted?***	The EAs web-based Flood Map combines detailed local data from modelling and mapping studies with information from a national model of England and Wales. For rivers, detailed survey data about the topography is combined with information on flows. For coastal areas, detailed survey data is combined with analysed sea level and wave data. Where detailed mapping is not available, data is supplemented with national generalised modelling for all rivers with a catchment size greater than 3km2 and the sea. SFRAs use all available data including local drainage, past events, hydraulic models (if existing), etc.	The "DACH Flood " software for the insurance industry is a probabilistic model to estimate financial losses and accumulated risk. It uses a rainfall-runoff approach and flood intensities at certain points, quantifying water depth, flow velocity and effects of debris impact. These parameters are related to damage using a series of vulnerability functions, considering insurance claim information, and engineering data and academic studies. The model is further calibrated considering gauge station data and historical flood data. In 2006, EQECAT released an upgrade of the original DACH model, enabling insurers to assess	No national standards. Each DDT uses different data. Often use historical high water records to assess to 1;100 year return periods.	Regulations demand risk maps of protected areas, areas along rivers/coasts and retention areas. Flood extent, depth and number of exposed citizens/economic activity is mapped for protected areas at risk of overtopping under certain conditions and rivers/coasts to simulations of 1:10, 1:100 and 1:1000 year.	Risk area classification, basic modelling information (hydrological, meteorological, geo-morphological and hydraulic assessments + historic records), land development scenarios (natural, developed). Pluvial assessment restricted to high risk areas. NB coordination between fluvial and coastal modelling has not been solved so far.	The agency producing the flood risk map will use all available data.	Flood hazard maps showing areas at risk to 1:1000, 1:100, 1:50 floods. Also show the potential socio-economic consequence. Other information deemed useful, such as identifying areas where there are floods with a high content of transported sediments and floods which can cause landslides or mud flows

	The private sector (e.g. JPA) produce improved resolution flood risk maps for the insurance industry and for SFRAs but these are not in the public domain.	building asset exposure along major German rivers and their tributaries. It includes a non-riverine flooding component which is viewed to cause significant losses. The system was developed to eventually be pan-European.					

1.8.3 Flood Risk Assessment and Maps ***Are there any flaws in risk mapping practices and are there any relevant model developments going on to overcome these flaws? In particular, what are their limitations in communicating flood risk?***	EA maps do not include pluvial flooding, nor is this made clear. EA pluvial flood maps are not in the public domain because they are only based on a 1:200 year rainfall event with full drains and a DTM which does not include infrastructure. Local SFRAs invariably lack pluvial flood data. No single agency compiles historic flood records. All flood risk maps only guide where a detailed assessment is required. They are not a substitute for an area specific detailed hydraulic model.		Quality of input data.	Pluvial flooding and groundwater flooding are not taken into account. The maps describe only a very limited amount of flood characteristics (i.e. flood depth and extent). The maps only show one failure mechanism, namely the overtopping of dikes, other failure mechanisms are ignored, although there are good reasons to believe that, for example, piping under dikes can cause dikes to collapse.	Resolution of input data (hydrological and hydraulic assessments, boundary conditions, model calibration). Pluvial flooding completely neglected.	Not applicable for Cyprus.	So far, risk maps have been locally generated with no specific template and usually in the context of a local research.
1.8.4 **Flood Risk Assessment and Maps** ***Are risk maps publically available? If not, who controls access to them?***	EA maps (excluding pluvial) and SFRAs are on the web. Catchment Flood Risk management Plans (CFRMPs), where they exist, are available on request from the EA.	Through the internet in several German Lander.	The maps are displayed by the Departmental Public Works Directorate or the IAU Ile-de-France websites. A website publishes the risk maps: prim.net and its subsets	Available online	Some web applications have been developed to display these maps	No risk maps available yet.	The preliminary flood risk assessment, flood hazard maps, flood risk maps and plans for flood risk management will be made available to the public.

	The EAs pluvial maps are currently only available under license to Local/ Regional Resilience Forums to use for emergency planning and to Planning Authorities for land use planning.		cartorisques.prim.net.				
1.8.5 Flood Risk Assessment and Maps ***As with most EU Directives and legislation, the Flood Directive will be implemented according to the principle of subsidiary. How will the FD affect mapping in your country, particularly compared to current practice?***	Lead Local authorities (county or unitary) are responsible for preliminary assessments, mapping and planning local flood risk. In line with the EA's strategic overview role they would support local authorities in undertaking their duties.		The Floods Directive will make the mapping systematic and will take into account the entire watershed - not the case at the moment.	The most difficult part of the EU Flood Directive for the Netherlands will be Flood risk management plans. For a number of flood types (such as pluvial flooding) no standards exist for a risk-based approach	Assessment is pending.	Not applicable.	
1.9.1 The role of the insurance industry ***Provide a review of the circumstances of the insurance industry within***	Until 2013 flood cover will be available as a standard feature of household and small business policies for a) those properties defended to a minimum standard of	In 2004 coverage was 10% of household contents and for 4% of residential buildings in all of the BRD. This "insurance penetration rate" is	Home insurance is compulsory. Since 1982, the CAT-NAT compensation scheme imposes a compulsory insurance premium to cover the	Since 1998 Government compensates for disaster losses, including flood but only provides compensation when a flood	Policies issued by the insurance companies in regard to property, personal accidents and life must include a clause covering these perils the	**I**nsurance companies are inactive in directly financing flood avoidance and mitigation. Their policies do not allow for "betterment".	The flood insurance policy is incorporated in the key property sector and the automotive industry.

your national context.	1 in 75 or b) for those properties where such defences are scheduled for completion within the next five years. Premiums will continue to reflect different degrees of risk. Insurance companies are inactive in directly financing flood resilience. All insurance companies are independent and in competition. One quarter of homeowners affected by the 2007 floods were not fully covered by insurance. The average cost of these floods was £25-30,000 per flooded home. and the average claim was £20,000.	low, but comparable to other central European countries such as Austria, Belgium, Italy and the Netherlands. Flood insurance is not available for buildings in the most flood hazard prone areas, and when available comes at especially high premiums.	consequences of "natural disasters" wherever the insured live. It is regulated by the Bureau Centrale de Tarification (BCT) and reinsurance is provided by the state owned Caisse Centrale de Reassurance (CCR). The cost of this natural disaster insurance is currently set at 12% of the premium of basic property policies (there is currently a proposal to increase this to 14%). Conditions: declaration of the event being a natural disaster by inter-Ministerial decree and that property damage insurance covers the damaged property, e.g. a causal link the catastrophe and the damage suffered.	results in a considerable disruption of public safety and requires a coordinated effort of organization and civil services. Currently, private insurance coverage against river flood damage is not generally available because of the existence of public compensation. However, homeowners/ businesses are at risk in case the government does not insure. A disadvantage of the current system is that it is not clear in which cases flood damage will be compensated.	losses of which are indemnified by CCS, within the framework of the Spanish natural catastrophe coverage system. CCS (the Insurance Consortium) covers all natural perils including flood, storm and tsumani throughout Spain. It works on a time compensation principle where over time bad years (in terms of compensation payments) are offset by good.	All insurance companies are independent and in competition.	
1.9.2 The role of the insurance industry ***Is flood insurance provided by the state, by a***	Insurance is only provided by private companies. We are unaware of companies differentiating between flood types.	In Germany flood insurance is now only provided by private companies. It is available for all buildings, even in the most flood	Natural disaster insurance (which includes flood) is compulsory; it is regulated by the Government and is provided by the	Private insurance against pluvial/groundwater flooding only is available and most homeowners take it out. The damage	Flood insurance is provided by CCS, a public entity working in collaboration with the private market.	By companies/ the market. Unlike car insurance, property insurance is NOT compulsory. Flood victims not covered	Flood insurance is only covered by insurance companies and not by the state. It is supplementary to the field of fire and it

public-private partnership or is it provided by companies/ the market? Are there any flood types that are not insured?		hazard prone areas. Approximately 1.5 % of all buildings are located in those areas. However, in flood hazard prone areas, additional prevention measures have to be taken, before insurance cover is provided. The average market penetration of natcat-cover is around 30 % in the end of 2010. Insurance companies in Germany also do not provide rate incentives for the installation of FRe features apart from a few exceptions. If FRe features are discussed between insurer and policyholder, it is mostly in those cases, where insurance cover can only be provided if flood prevention measures are installed first. Since 2009 natural	private insurance sector with the Government offering guaranteed reinsurance. To be eligible a flood must be recognised as a natural catastrophe (generally when the flood exceeds a 1:10 year event). As a rule (Insurer's Code), this applies when the flood has a return period of over 10 years. Premiums can be raised according to flood record (but are generally not- see 1.9E and 1.9F) and refused if building on an area designated to be at risk of flooding.	should be directly and solely related to local extreme rainfall. Flooding from rivers, sea or groundwater is not insurable and therefore if pluvial flooding coincides with other flood types, the damage is not insured. Furthermore, the rainfall event should have a minimum intensity to be considered as 'extreme' (higher than 40mm /24hours, 67mm/72hours).		by insurance have been compensated by Government.	is part of the packages offered by companies. All flood types are insured in Greece.

		catastrophe loss insurance is now included right from the outset This comprehensive insurance will also raise the awareness of the general public to the need for protection against the consequences of natural hazards.					
1.9.3 The role of the insurance industry ***Are there any differences between the insurance arrangements of an owner-occupied house and a rented house?***	Owners insurer buildings; tenants insure contents.	Owners insurer the buildings. Tenants insure contents.	No	Owners insurer the buildings. Tenants insure contents.	No difference	Owners insurer the buildings. Tenants insure contents.	The difference is that the owner is always more cautious than the tenant.
1.9.4 The role of the insurance industry ***Is insurance cover compulsory or voluntary and is there any type of flood that is not insurable?***	No but insurance cover is often a condition for a mortgage loan. Flood risk is usually covered as a standard part of business and household property insurances.	Voluntary but bank mortgage loans often ask for flood insurance.	Compulsory. All types of flooding are insured.	Property and content insurance is only obligatory if a mortgage is obtained from a bank.	Compulsory	Insurance cover is often a condition of mortgage (financial loan) offers. Flood risk is usually covered as a standard part of business and household insurance.	Insurance cover is voluntary and not mandatory
1.9.5 The role of the insurance industry	Individual companies will assess risk and punitive measures	Flood prone structures pay higher premiums	Insurance companies cannot take punitive measures excepted in	This is not the case for frequent pluvial flooding with only	None	Each individual company assesses both flood risk, and	After the event and the relevant loss, the important factors

What if any punitive measures do insurance companies put on previously flooded or 'at risk' claimants? Please provide examples.	based on previous claims. The Association of British Insurers (ABI) has warned that the agreement to provide insurance up to 2013 will not be renewed unless the Government increases the amount of money it spends on flood protection.		the case described in B. In fact, until now companies did not modulate the premium cost.	small related damages.		punitive measures to claimants, individually.	to be examined by an insurance company are the nature of the damage, the size, the reason which caused it and if it can be restored. This may lead to a premium.
1.9.6 The role of the insurance industry ***Do protection measures have an impact upon premium cost?***	In theory, yes. However, each company acts independently	Temporary protection measures currently have no impact on premium costs. Currently the insurance industry provides little or no incentives to policyholders who implement flood preparedness.	In areas where the risk is well-known, and dwellers have been flooded several time, the existence of a PPRi (and the implementation of prescribed protection measures) the insurance company cannot raise the premium cost.	As far as we know, insurances do not take protective measures in to account.	No	In theory, yes. However, each company acts independently	No
1.9.7 The role of the insurance industry ***How does the insurance industry assist the uptake of FRe in your country for risk reduction?***	Through publicity and advice to home owners by individual companies and the ABI. In some case by offering reduced premiums. On occasion insurers will stipulate that homeowners must adopt FRe prior to	A study comparing flood insurance schemes in France, the UK, and the US found flood insurance in Germany to be the least effective in encouraging awareness of flood risks and pro-action to mitigate losses.	Insurance industry doesn't assist the uptake of FRe in France. But, there is a risk prevention fund provided by the state. For instance, a private individual who want to put barriers to protect his house or a local authority, who want to make an information	At the moment they are not interested in FRe. However, for insurance companies pluvial flood damages are relatively small compared to the overall damage claims they receive.	The State insurance scheme provides financial support for research on natural perils. Private insurance companies do not play any role in this field because they do not take part in the coverage of these perils.	Via SMARTeST	Not known of, but possibly in the future.

	offering home insurance. In some cases insurers will not insure if the repairs to a property are not resilient.	Insurance companies do not provide rate incentives for the installation of FRe features.	campaign, can be granted thanks to this fund.		Spreading awareness through free publications		
1.9.8 The role of the insurance industry ***In what way does the insurance industry hinder the uptake of FRe in your country?***	There is a lack of a national approach to FRe by companies, partly due to the industry's competitive nature. Insurers do not, as a rule, provide or pay for FRe. 'No betterment' clauses prevent insurance companies from assisting in the finance of FRe products post-claims.	Insurance companies tend to be extremely slow in implementing changes, even when there are substantial benefits to be gained.	Insurance companies re-instate only. The present organisation of the insurance industry probably hinders the uptake of FRe, because they don't take into account the risk in the premium cost. An owner of a house, which was already flooded, doesn't pay more than other owner. However, the national compensation schemes must be accompanied by a loss prevention system.	The Netherlands doesn't have a good solution for insuring fluvial flooding by private means. Therefore, there is no effective way for the insurance sector to assist FRe.	Spanish Insurances Consortium has proved to be so efficient in subsidies that populations at regular flood risk rely deeply on its assistance. Consequently, this "welfare" institution tends to mitigate particular incentives for FRe measures implementation and thus turns itself into an authentic barrier to their development	Lack of awareness. Don't provide FRe.	
1.9.9 The role of the insurance industry ***How should the insurance industry facilitate the uptake of FRe within your country?***	Scrapping the 'betterment' clause and active participation in provision of FRe products/systems. Align FRe with building completion certificates. Without a certificate, buildings	Insurance companies should provide information and incentives for the uptake of Fre, because it is in their own interest.	The insurance industry could facilitate the uptake of FRe by implementing punitive measures on houses previously flooded and probably even more by reducing the premium cost of the ones who have implemented	There is no reason why the insurance industry should facilitate the uptake of FRe, after all this is a decision to be taken by home owners (at local level) and water authorities (at regional level).	The CCS constantly seeks alternative solutions and is considering applying a deduction on indemnities against frequent losses.	There may be scope to align FRe with insurance premiums in flood risk areas.	Today, there is none.

	will not obtain insurance.		FRe in their house.	Insurance industry has no role in fluvial flooding (see H)			
1.*10.1 Innovation and dissemination of FRe features *Are there any policies to support the development of innovative/ 'smart' FRe features and the industry generally in your country?	Defra grant scheme provides money to individual households who have been flooded and are at risk of being flooded again in 1:20 years or less. The scheme allows for up to £7,500 per household. Some general policies such as shift to research assessments considering impact and collaboration with industry and a green investment bank to help fund adaptation technologies *may* have applicability to FRe.	The act to improve Precautionary Flood Control and the EU Flood Directive hopefully will lead to policies that support FRe features. Industrial innovations in technologies already are promising	As far as we know, there is no incentive for industries.	In the policy document 'Water Safety' (2009) a more holistic approach in water management and spatial planning is advised. Areas were FRe can be useful: risk-zoning of areas, protecting vital infrastructures, compartmentalisation and building in outer-dike areas. In principle the Netherlands favours large durable heavy engineered solutions.	Regional Government (e.g. Valencia which is a model for Spain) is responsible to support financially the building/infrastructure adaptation to flood risk. This is a clear (enforceable) policy to support the development of innovative/ 'smart' FRe features. Technological norms are being developed.	Not yet	There are no such policies proposed or implemented so far
1.10.2 Innovation and dissemination of FRe features *What are the main challenges to the technological development of*	Testing procedures/BSI standards and Kitemark certification is not 'fit for purpose'. "Sandbag mentality". Lack of support for product development and testing within the	Many decision-makers received an education that concentrated on Structural Flood defence and view the concept of "living with floods' sceptically. The	Main challenges are access to the market, normalization, the improvement of aesthetical aspects. Currently, FRe technologies aren't widely used.	The Netherlands only have little knowledge in doing so. They see new development in flood-prone areas as challenges to develop more	The insurance industry. The Spanish Insurances Consortium has proved to be so efficient in subsidies that populations at regular flood risk rely deeply on its	Flood resistance does not carry the same weight as building regulations and there is, therefore, fewer obligations on developers/ buyers to adopt FRe.	Lack of funding. Lack of political will towards technological development of FRe features. Lack of previous relevant experience

FRe features?	industry due to the fear that products do not have enough demand.	biggest challenge seems to lie in educating the established civil engineers who believe that they "have seen it all" in their long careers. Government gives flood prone property owners a false sense of security.		durable solutions. Areas were FRe can be useful: risk-zoning of areas, protecting vital infrastructures, compartmentation and building in outer-dike areas.	assistance. Consequently, this "welfare" institution tends to mitigate particular incentives for FRe measures implementation and thus turns itself into an authentic barrier to their development.	Sandbag mentality and industry not well established.	
1.10.3 **Innovation and dissemination of FRe features** ***How is innovation disseminated in your country and what are the barriers to this?***	Through the cross-council research programmes such as Living With Environmental Change. Social learning and forming networks.	*Ad hoc* disaster relief through the Federal Government gives flood prone property owners a false sense of risk security and a disincentive for private initiatives.	No official process.	Limited to *ad hoc* examples- in Delft, a the private sector is cooperating with the municipality and TU Delft in demonstrating FRe technology in a public area.	Via regional water plans and a water data bank. Overall, very little is being done to disseminate innovation in Spain.	Fairs/exhibitions and importers' marketing	Innovation is usually disseminated via research projects and relevant results
1.11.1 Responsibility of the general public/ local communities at risk ***How have the 'responsibilities' of the general***	Community 'responsibility' for the uptake of FRe systems and technology is likely to increase due to the cutbacks enforced on the EA and LAs.			Government policy is that everyone is responsible to mitigate risks as much as possible by themselves. For pluvial flooding for example, there should be enough	The Floods Directive also calls for public implication in flood risk management, and this will suppose a new challenge, but insurance system may become a	Experience of flooding, and media reports of flood events elsewhere, act to increase awareness of flooding and of flood resilience measures.	The Local Government intervention has increased since local communities started establishing bodies which allow the participation of citizens. Such

public/ communities regarding flood risks been altered over time, and how are these likely to change in the coming years?				filtration options or storage on the property area. Building outside areas protected by dikes is at own risk (the government accepts responsibility in inner-dike areas).	constraint for its implementation.	For the most part, it has been left to individual homeowners to purchase and deploy features to protect their property, or to make their property flood resilient/ resistant.	bodies intend to push forward the appropriate action but official approval is often either slow or not granted.
1.11.2 **Responsibility of the general public/ local communities at risk** ***What effort has been made to help local people at risk to understand flood risk?***	EA and the media constantly raise awareness. National Flood Forum (a charity) provide support and advice. The ABI issue guidance documents. SFRAs (where they exist) are on the web. LAs civil contingency depts. publicise risk when it is recognised.	A lack of awareness and information about flood risk among individuals and insurers impedes German flood loss mitigation and preparedness. 59% of the households affected by the River Elbe Flood of 2002 stated that they did not know they lived in a flood prone area.	Documents describing risks to the municipality and emergency procedures.	Website	Flood risk dissemination campaigns among the population; annual informative campaigns addressed to Municipalities and via web informative platforms.	News coverage. Coastal flooding is a recurring problem well publicised by the press. People in these areas understand flood risk and take simple flood resilience measures such as avoiding use of carpets and timber floors, storing electrical good at low elevations etc.	The above mentioned bodies organize workshops but such activities require to be initially approved by the supervising Ministry of Environment, Energy & Climate Change.
1.11.3 Responsibility of the general public/ local communities at risk ***What initiatives have been used to help local people with the uptake of FRe?***	See 1.10 A above r.e. Defra's grant scheme. Some utility companies occasionally offer assistance to previously flooded households.	Several states have developed booklets that outline FRe practices and techniques.	Financial incentives implemented by County Councils, groupings of local authorities and the National Fund for Natural Hazard Prevention (Fonds Barnier)	Cities usually offer some information on pluvial flooding on their website or through leaflets, mentioning the risk and the possible measures. As far as we know, no initiatives exist to stimulate the	For example "FRe garage ramps", despite not being legally enforceable, are sometimes used as a condition of building permits. In project alterations, the developer is asked to integrate	None yet.	Interventions relate to all civil protection and risk faced by urban areas from flooding but economic cutbacks mean few currently scheduled.

				uptake of FRe products in case of fluvial flooding	this FRe measure		
**********	**********	**********	**********	**********	**********	**********	**********
2.1 Recent flood events and 'policy windows' ***Provide a brief review of notable recent flood events (10 - 20 years), that has influenced subsequent policy decisions and/or has had policy implications. We are particularly interested in assessing how policy and practice been affected by flood events or in the face of increased risk and vulnerability.***	Conceptual shift to 'living with water' and resilience in built environment, but this has not yet been actioned in any serious way. Funds and knowledge are still needed to facilitate FRe.	Various serious flood events over the last 20 years have broadened public recognition of flood proofing and public demand for action on flood defence, culminating in the 2005 Act to improve precautionary flood control. Compensation paid led public to believe that flood damage compensation and flood defence are a government responsibility which constrains FRe uptake.	Hard to distinguish FRe responses from general risk management issues. FRe is promoted for risk reduction regardless of past events. Action Programme for Prevention of Floods aims to improve awareness. However, there is still a lack of cost/benefit analysis in decision making and a poor culture of risk. Feb. 2010 storm resulted in government proposing a new risk policy and declaring areas unsuitable for habitation (1,600 houses compulsory purchased and destroyed).	Post serious storm induced floods in 1998 and 2003 government accepted responsibility for river flooding as a result of failure of primary flood protection structures. This hampers the uptake of FRe technology. The Dutch government would like to see private companies play a more active role in providing insurance. Citizens should be more responsible for their own properties. If current discussion on responsibility continues in this direction, this may provide opportunities for uptake of FRe.	Serious flood events have resulted in structural responses. <u>*No comments re how policies have driven/constrained FRe*</u>	2 deaths from flash floods in Paphos in 2006.	Most of the flood events are usually caused by sudden storm events (either short or extensive), the civil protection measures are usually lacking beforehand Difficult to forecast the magnitude and the affected areas in time. The public response is usually to return to one's residence and protect their property while even in cases where that does not apply as the safest result.

2.1.2 Recent flood events and 'policy windows' ***To what level of probability do authorities in your country seek to instigate flood protection? (For example 1 in 100 years). To what extent do they include provision for climate change?***	The EA try to achieve 1:100 protections for fluvial schemes and 1:200 for coastal but actual level is determined by a cost/benefit analysis and can be as low as 1:25 in some cases where better protection is not feasible. Climate change allowances (to 2115): For sea level rise variable bands dependant on time/location between 2.6 and 15 mm/year. For fluvial rainfall between 5% and 30% dependant on time and between 10% and 20% for river flow.	HQ 100, or the 100-year frequency storm is widely used as the design storm. It is generally acknowledged that climate change will bring increases in the frequency and intensity of flooding. Design storms, though have not yet been amended.	France characterizes different types of floods according to their frequency and to their local characteristics according to historical floods. Local vulnerabilities determine rule of construction with the PPR (Risk Prevention Plan). Examples vary between 1:100 and 1:50 +20cm.	Post 1953 disasters the Government undertakes a cost/benefit analysis. 8 million people living below sea level in the densely populated western part of the country dikes designed to T = 10,000 years This was a 1960 assessment and now. 1M could be more realistic. Water levels derived to these return periods T = 4000 years, T = 2,500 years, and T = 1,250. determine the height of the dike in the rest of the country	1:100 for correcting measures. Infrastructure is variable: dams and spillways1:500 to 1:10,000; river channelling 1:25 to 1:500. Land use restrictions in 3 zones: to 1:25; to 1:00 and to 1:500.	Dependant on area: rural1:1; residential 1:2; city centres/industrial 1:5; main drains1:10; watercourses 1:25; bridges over roads 1:50 and over motorways 1:150. No allowance for CC but sea level rise is taken into account.	The Greek authorities study the flood probability based on scenarios 1:1000, 1:100 and 1:50. Flood protection is yet to be correlated with climate change in Greece.

2.2.1 Building regulations ***What are the stated aims, objectives and types of building standards /regulations that are currently in use?***	Since 2010, the ability of a local authority to ensure flood resistance material is used 'where appropriate' is enshrined in law.	New building and enlargement or modifications of existing buildings, including construction of oil heating systems on floodplains only allowed subject certain criteria. Currently there are only vague requirements concerning construction norms and materials to be used in flood prone houses.	Only cover new build. There is presently no guidance available concerning flood resilient materials or flood resilient building design (except re buoyancy of fuel/gas tanks and underground infrastructure), but builders recognize that water can cause damage. Testing procedures only assess 'soft' situations and are not specifically designed to cope with flooding.	National and City regulations state that buildings should be watertight, so water from the surface and groundwater cannot enter the building. They also prescribe a minimum level of water provisions (such as toilets) above mean street level.	Little attention given to flood risk, few regulations and poorly enforced (dependant on local councils). However, Regional Government is responsible for financial help for adaptation of at risk buildings/ infrastructure. New buildings must be orientated according to the flood flow direction, in order to mitigate the barrier effect of the building.	Building Regulations require that properties have adequate drainage. There are no requirements for water harvesting / cistern, absorption pits or flood resilience.	Currently, the Greek Municipalities do not apply a specific regulation for flood protection. There is no Greek relevant regulation. However, studies tend to take after the English and French specifications when necessary.
2.2.2 Building regulations ***What are the stated aims, objectives and types of building standards /regulations that could be used in the future?***	The Pitt Review noted: "Building Regulations should be revised to ensure that all new or refurbished buildings in high flood-risk areas are flood-resistant or resilient."	Uniform specifications for the construction, and maintenance of Fre measures are needed in the future. States have issued advisory reports for municipalities that describe a system of "building passports" that contain information relevant to flood management. When	Works are being carried out to derive guidance for the refurbishment of existing buildings after floods. Development of amphibious buildings is rather controversial: argument for is ability to build in at risk areas; argument against is safety.	No revisions foreseen.	Building standards are not considered a priority option, so in the near future, no emphasis should be expected at this regard.		In the future there should be a committee with the purpose to compile a single flood regulation.

		buildings are being sold this information would be available to the new owners.					
2.3 Policy context **What are the main (general) policy initiatives affecting the uptake of FRe over the past number of years?** ***Consider these in terms of a) those that have supported the uptake of FRe and b) those that have restricted the uptake of FRe. Can examples of 'best' and 'worst' practice be provided?***	General: The first recommendation of the Pitt Review states: "the Government should give priority to both adaptation and mitigation in its programmes to help society cope with climate change." *Living with risk* agenda – attempts to persuade people that they should use resistance measures and to 'live with water'. Specific: EU Flood Directive is enshrined in national legislation. Local Authorities have increased responsibilities and capacity. And County Councils and unitary authorities have a lead role in FRM. Climate Change act looks at adaptation. PPS25 seeks to ensure that flood risk is taken into account	General: FRM is generally recognized as "living with floods". Risk management requires structural and non-structural measures including legislation, policies, plans, regulations, and norms targeting land use planning and building codes. Specific: A hierarchy from the EU Flood Directive over the federal Water Resources Act, Regional Planning Act, Regional Planning Procedure, down to the local Land Use Plan and the Master Zoning Plan. Private persons to take precautions to avoid flood losses. The Regional Planning Act requires development plan to include retention areas for flood	Since 1982, (the CAT-NAT compensation scheme which imposes a compulsory insurance premium to cover the consequences of "natural disasters" wherever the insured live) public policy has encouraged evaluation of vulnerability.	Flood prevention is the main governmental policy. 2009 policy document and 2010 National Water Plan address a more holistic approach to FRM to include new innovative defence structures which have multiple functions and durable spatial developments. Although the focus is on fluvial and coastal flooding and more related to catchment scale flooding, these policy documents may positively affect the uptake of FRe in urban areas as well.	Traditionally, in Spain, structural measures (paradigmatic FRe solutions) have been successfully adopted, rather than other kinds of solutions. Huge areas having been built-up on flood plains and are now irreversibly under a high flood risk. Unfortunately, this political misdemeanour is now a real appeal for FRe product	General Cyprus, as a member state of the EU is preparing for climate change and living with the floods. Adaptation is a general policy No specific measures yet	There has been no prior policy initiative affecting the uptake of FRe other than the implementation of the EU Floods Directive which is now underway along with the relevant Greek Legislation. Events recorded so far are usually a combination of faulty or incomplete measures and random events thus storm events resulting in disproportionate effects.

	at all stages of the planning process and aims to avoid development in areas at risk of flooding (see also 1.3 and 1.4 r.e. spatial planning).	protection. 2005 Act implements (i) land use control including floodplain mapping, (ii) flood preparedness, (iii) capacity building of stakeholders, and (iv) contingency planning and plans to provide more retention on rivers and to reduce flood losses through spatial planning and European cooperation.					
2.4 Regulatory implications	The ability of a local authority to ensure flood resistance material is used is enshrined in law. Building standards touch upon water inundation.	Some Municipalities are forming partnerships to meet future demands	Procedure Risk Prevention Planning = red zone (attendant measures) Blue / orange zone (restriction in flood plains)	The Dutch National Water (2009) Act and National Governmental Agreement for Water, second edition (2008) are important driver for investments in flood protection.	FRe not properly taken into account in regulations and water is seen rather as a resource than a risk. The definition of possible uses and development options of areas at flood risk is still pending.	None	No regs with regard to FRe. If necessary, regulations are usually set by the system manufacturers and then adopted by Government.
2.5.1 Political context ***What are the primary political drivers for the uptake of FRe? Is this a contemporary***	It is increasingly recognised that flooding is an issue of public safety – pushing it further up the political and policy agenda. Recognition that	NGO's are a primary political driver, seeing to it that state governments are doing their job.	The imposition of the EU of the Floods Directive and the revision of the CAT-NAT insurance scheme are two major elements of the evolutions which are	There is not much political attention on FRe technology at the moment.	Drivers are Housing Institutes and Autonomous Regions. It is not a special political issue in Spain nowadays.	Public safety. Media portraying shortage of flood protection as well as poor design and maintenance.	There is no specific FRe system and technology uptake in Greece thus the above questions cannot be answered for the case of Greece.

political issue in your country?	floods cannot be defended against led to a political need to shift responsibility for flood protection *from* the state.		under way. The market pressure on land is so high that the flood question is a political issue.		Administrations and the public in general rely on the insurance system in a certain way.		
2.5.2 Political context ***Can political resistance to FRe uptake be identified?***	Local authorities may provide resistance to the increased responsibilities that are being transferred to them. Bidding for FRe will be competitive and will have an element of politics.	2010 DWA audit notes that today state and municipal resources are still being primarily made available for technical flood defence and that only a fraction of funds is being spent on implementing strategies to improve flood resilience.		There is not clear resistance, other than the traditionally conservative culture of water authorities.	Conflicts in the required administrative coordination.	Bidding for FRe will be competitive and will have an element of politics.	
2.5.3 Political context ***Can public resistance to FRe uptake be identified?***	The visibility of FRe is a concern as homeowners think visible FRe devalues their most important asset. There is also a fear that by having FRe they will be recorded as 'at risk'. From a public perspective therefore, SMART resilience may therefore be one that is neither 'visible' nor formally/ officially recorded. Era-Net Crue	There is a general unwillingness of private property owners to invest funds for their own flood-proofing. 2002 survey found that just 11% of households had used and furnished their house in a flood adapted way and only 6% had a flood adapted building structure.	The CAT-NAT insurance scheme is not incentive but is being improved in order to foster the development of more responsible behaviors at a collective and at the individual levels.	People tend to think that only the government is responsible for their safety.	The greatest public resistance is caused by the legal restrictions to land uses that have been generated by the enforcement of flood risk criteria in development planning regulations.	Visibility of FRe is a concern.	

	research in Heywood suggested that the public are reluctant to spend money on FRe products even after having experienced flooding.						
2.6 The EU Flood Directive Each member state has a degree of discretion in how the EU Flood Directive is being implemented. Is there evidence that this flexibility has either facilitated or constrained FRe uptake? Can you identify barriers to the implementation of this Directive?	It is unlikely that the Directive will have any *direct* impact upon the uptake of FRe. However, it is assumed that better mapping and assessments may lead to more awareness of flooding and therefore *indirectly* support greater uptake of FRe.	Responsibility for implementation of the EU Flood Directive has been placed on the states of the BRD. Floodplain delineation and preparation of plans requires funding by the states at levels measured in millions of EUR. All states are carrying out this task to the best of their abilities.	Floods Directive is seen as an opportunity to renovate and organize the French policy and establish a national strategy and by empowering local stakeholder involvement in FRM.	The Dutch government will not change a lot in their flood management policies after implementation.	Implementation depends on funds available for flood policies in each State, depending on the funds extend, specific FRe measures will be implemented or not and public budget cuts also impact at this regard. Lack of accuracy in the detail level required for the implementation.	Unlikely to have any *direct* impact upon the uptake of FRe but better mapping and assessments may lead to more awareness of flooding and therefore *indirectly* support greater uptake of FRe.	None identified. The implementation of the EU Floods Directive and relevant Greek Legislation is underway and there has been no specific reference to FRe uptake so far.
2.7.1 The economic impacts of FRe *Has there been research detailing the financial costs of flooding/ flood events in*	The 2004 foresight future flooding report suggested that the annual damage (£m) of floods in the UK would raise from their 2004 level of 1,400 to 20,500 by 2080, dependant upon	Flood damage of the 1993/94 floods in Cologne was 5000 million DM; the 1997 Oder flood caused rescue expenses of 2000 million DM; the 1999 Danube flood cost	8.000 French urban centres, housing 4.5 million people, face flood risks. From 1994 to 2004, floods cost France between €100 and €900 million annually. CCR estimate the cost	1953 resulted in nearly 2000 fatalities; 1998 cost 900 million gulders; 2003 resulted in 223 claims costing Euro 4.5 million.	Increase 1980 – 2010 from Euros 300 million to 800 million per annum. Decrease in casualties of 1400 in 1950 to near zero in 2010.	Not yet.	Some research is currently underway.

your country? Are there projected future annual cost?	which scenario was used. The 2007 flood cost homeowners, businesses, emergency services and others some £3.2bn. The average cost of these floods was £25-30,000 per flooded home. and the average claim was£20,000.	400 million EUR and the 2002 flood of Elbe and Oder caused a damage of 9.2 billion EUR.	of direct damage from a flood that occurs every hundred years in the Paris area at about € 11 billion.		Criteria for assessing the cost of structural damage to buildings.		
2.7.2 The economic impacts of FRe ***Has there been an assessment of the economic benefits of FRe uptake in your country? If so please provide details on how these are calculated and the reliability and accuracy of the assessment methodology.***	Around 5.2 million homes in England are currently at risk of flooding, 2.8 million of which are at risk from flooding due to surface water, according to the Environment Agency. Nearly 500,000 people face a significant flood risk, and the ABI warned this figure could rise to 840,000 by 2035 without adequate investment in flood defences. A 2007 Defra study found resistance measures are economically	No uniform calculations have been conducted.	No assessment of cost-benefit.	Not as far as we know.	No information.	Not yet.	No such assessment.

	worthwhile for properties with an annual chance of flooding of 2%+ (50 year return period) and increase substantially if flooding is more frequent. Temporary resistance measures (temporary flood guards and airbrick covers) reduce the costs of damage by about 50% if they are properly deployed prior to a flood .						
2.7.3 The economic impacts of FRe ***How are the economic benefits of FRe uptake compared to other – more traditional – risk reduction measures?***	EA estimate that for every £1 spent on flood defences (not necessarily FRe) the country saves £8 in the future in terms of reduced damage. In one area that was studied, it was found cheaper to provide the approx 80 houses which are constantly at risk of flooding with household FRe measures rather than the installation of FRe systems to protect the area under threat.	No special studies known.	Little used.		In most cases in Spain, they have to be checked case by case.	Not applicable.	
2.7.4 **The**	Still a perception by	No financial	The cost (economical)	Since the	Probably yes,	Still a perception by	

economic impacts of FRe ***How has the cost/ funding of FRe limited uptake in your country?***	many that Flood defence should be provided by the state. Uncertainty remains on how deep cuts to funding on flood defences might be (20% in some citations), while the risk of flooding is set to increase as the UK..	incentives exist for self-protection measures taken by private property owners. Property owners continue to believe that financial flood relief be paid by government and through private fundraising.	factor and the insurance context are the major limitations of FRe uptake.	government is providing most flood protection, they also bear the costs of FRe measures. The level of investment in flood protection such as dikes and weirs is high compared to other countries, so it is unlikely that costs would be a barrier for uptake.	because this cost has to be taken on by the public in general at large. They prefer to transfer the cost to the State or to the Insurance Industry	many that Flood defence should be provided by the state. Need for FRe to be subsidised, at least in the short term.	
2.7.5 The economic impacts of FRe ***Briefly describe any economic incentives and the availability of grants or loans for FRe in your country.***	Defra grant scheme provides money to individual households who have been flooded and are at risk of being flooded again in 1:20 years or less. The scheme allows for up to £7,500 per household.	State agencies implement selected flood conveyance and multi-functional levee projects for communities.	None- particularly due to the insurance system	None, but government has cooperated on an ad hoc basis with FRe manufacturers on FRe development and implementation.	No special grants are available in Spain, but occasional economical incentives.	None available.	There are no relevant incentives / loans or grants. There are no such concerns in the context of flood protection projects.
2.8.1The societal impacts of flooding ***How have societal drivers (for instance special stakeholders) facilitated the uptake of FRe?***	A lobby group and past events raise awareness but public perception of flood risk is low and confidence in the effectiveness of FRe measures is also low. Thus all FRe products need to be	The main societal driver in Germany is the states that carry the financial burden of funding mitigation.	No. People expect the state to protect them.		No special stakeholders.	Flood events raise consciousness.	

	simple and they must be seen to work.						
2.8.2 The societal impacts of flooding ***Is there evidence that societal factors (or public opinion) restrict the uptake of FRe?***	Increasingly fragmented society makes it difficult for communities to work together. Leaving flood doors outside unattended properties can indicate vacancy and attract potential burglary. People are deterred from taking action because they feel they are expensive or not their responsibility. Concern that FRe measures might adversely affect property values or make them hard to sell.	There is interest in Fre use, as long as the government pays for it. In most places in Germany there seems to be strong objections to self-protection by the property owner, requiring them to pay for protective measures.	No, if we consider that dykes are categorised as FRe systems. Yes, if we consider people do not want to live with the risk, to appropriate and accept it, they don't consider ways to be resilient (through technologies).		No evidence.	Increasingly fragmented society makes it difficult for communities to work together.	
2.8.3 The societal impacts of flooding ***To what extent has stakeholder participation been practiced?***	Protecting individual houses with flood gates requires community participation. This exists where the LA organised the local flood watch. Lobby group provides	Stakeholder participation is still a novelty in both the formerly Communist new states of the republic and the old democratic Western Germany.	Citizens are not consulted for risk prevention. After a disaster, victims of flood participate in a legal approach when they want to affirm their rights.		Just putting pressure on Public Administrations.	Shops in Paphos coastal area are getting organised to address the coastal flooding problem.	

	support and advice to communities and individuals that have been flooded or are at risk of flooding.						
2.8.4* The societal impacts of flooding *What kind of stakeholder information and learning programs already exist?	Organisations such as The National Flood Forum, the ABI, the EA and LAs provide advice on flood protection in general on their web sites. Stakeholder learning programmes are at best haphazard and at worse non-existent.		Many informative tools are available for flood prevention; from State (www.prim.net), insurances, local authorities, research centers. In spite of these efforts, the available information is not yet appropriate and needs more promotion.		A programme is being developed	None	
2.9 Best practice	See Defra's grant scheme described under 1.10 above Reaction of Eden District Council in Eamont and Appleby- see 2.8A above. BRE are currently establishing an innovation park in Scotland which could showcase good FRe systems and tools deployment. FRe products need to be simple to install and to operate if they are to gain public confidence/ acceptance.	Giving more space and flood storage to rivers involved the recent re-naturalisation of twelve major rivers including Ems, Lippe, Ruhr, Sieg, Erft, Niers, in North-Rhine-Westphalia. Overflow sills attached to levies, subdivision of polders, compartmentalisation through roads and railway embankments	On the Loire river (answer to develop). Insurance industry doesn't assist the uptake of FRe in France. But, there is a risk prevention fund provided by the state. For instance, a private individual who wants to put barriers to protect his house or a local authority, who want to make an information campaign, can apply for funds.	Urban flood risk management Dordrecht: this project is a Public Private Partnerships where research is done on innovative and durable urban development and water management. They develop knowledge needed to deal with future flood risks. A pilot project on floating and amphibious homes in the Netherlands,	Creation of a specific public body, within Valencia's regional Administration, but this is not a preventive FRe measure. Creation of 'Flood Damages Assessment Guidance' in order to repair flood consequences. Successfully applied in 2007, in occasion of the disastrous. Valencia's floods.	Not applicable.	65km Athens ring road designed to improve rainwater distribution in the entire basin and to contribute to flood protection.

				Maasbommel: http://www.duravermeerbusinessdevelopment.nl/project_info.asp?id=483	Whilst this review is related to Valencia should be interpreted as available for the 16 remaining Spanish Autonomous regions.		
2.10 Worst practice	Use of 1 in 100 year or 0.1% does not adequately convey risk.	A couple of examples re individual building projects.	Lack of balance between collective solutions developed by the water and sanitation service and the solutions developed by individuals. Lack of communication between the water and sanitation service and individuals: the installation of barriers to protect individual properties hampered the expansion of water in a whole area.		Lack in regulation enforcement	Not applicable.	
Question	**United Kingdom**	**Germany**	**France**	**Netherlands**	**Spain**	**Cyprus**	**Greece**