SMARTeST

Integration of Flood Resilience Technologies,

Integration of Flood Resilience Technologies, Systems and Tools

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3. Passau, Germany (Irish Examiner http://www.irishexaminer.com/breakingnews/world/flooding-in-german-city-dramatic-596401.html)
4. Flooding Sign (Google, viewed on ITV http://www.itv.com/news/meridian/2012-04-29/rain-lashes-the-south-sparking-flood-alerts/

The SMARTeST Project

The SMARTeST project was funded under the European Union's FP7 Research Programme, in the area Technologies for improved safety of the built environment in relation to flood events (ENV.2009.3.1.5.1).

The extent and consequences of recent flood events in Europe and worldwide have shown that existing flood defence structures do not guarantee sufficient protection for people and properties. Due to climate change and rapid urbanisation the situation is likely to become more severe. In this unfavourably changing environment, a substantial rethinking of existing strategies and a paradigm shift from the traditional approaches is required in order to cope with future flooding in an adequate way.

The SMARTeST project (Smart Resilient Technologies, Systems and Tools) was conceived in order to address many of the issues of integration of flood resilience (FRe) technology into the overall approach to flood risk management. The project has developed and disseminated knowledge to help facilitate flood resilience across Europe. It has identified challenges to the design and integration of FRe technologies and isolated opportunities for their promotion. The project was designed to improve the road to market for FRe technologies, particularly those with innovative or 'smart' FRe features. These features rely less upon human intervention for their deployment, although correct use, installation and maintenance are critical to improving their overall effectiveness. Beyond innovative technologies, the project has also developed FRe modelling and decision-making, again with an ultimate aspiration to promote the growth of more resilient societies. The emphasis is on cost effective solutions to flood resilient systems in the urban environment.

The project has achieved the following:

- Development of guidance for standards makers on FRe technology;
- Understanding of FRe systems intended to incorporate FRe technology;
- Development of a series of models and tools that support integration;
- Understanding stakeholder needs for the integration of FRe technology, systems and tools;
- Production of guidance for professionals and individuals.

The project has been coordinated by the Building Research Establishment of the UK, and has involved 10 European research institutes. It has been supported by National Support Groups in each country and an International Application and Implementation Group (see www.floodresilience.eu for details).

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Other SMARTeST reports

Flood Resilience Technologies

Guidance for Flood Resilience Systems

Flood Resilience Models

Executive Summary

This research report, based upon findings from the SMARTeST Project, proposes how the potential of flood resilient products may be realised. The findings were developed through an analysis of the barriers to - and opportunities for - the integration of flood resilient technologies, tools and systems into current and future flood management activity. This led to the development of a series of principles and practical initiatives that will support flood resilience in both policy and practice.

Three broad principles should be promoted to support the integration of flood resilient technologies: **Awareness** of flood resilience technologies and the contribution they can make to regimes of flood management; **Acceptance** of the efficacy of flood resilient technology and responsibility for their integration; and efforts to support **Action**, or to support the capacity of individuals, communities and stakeholders to install, maintain and use flood resilient technology.

To realise these principles, we have further identified six sequential practical steps that, combined, will help ensure FRe becomes an accepted part of a wider flood risk management strategies. The steps are:

Step 1: *Understanding the risk*

Step 2: *Planning - first considerations*.

Step 3: *Surveying*.

Step 4: *Design and Specification.*

Step 5: *Product installation*.

Step 6: *Operation and maintenance*.

These should be disseminated to communities and other stakeholders through independent and trusted guidance documents. These steps may be adapted according to national and regional contexts.

Beyond these practical initiatives, the research identified the need for other strategic interventions to support the development and use of flood resilient technologies. First, there is a need to incubate innovation-friendly contexts for product development. Testing regimes and certification must be robust, transparent and independently verified. Moreover, stakeholders must be consulted during the development of products to help raise acceptance of FRe, and ultimately provide a foundation for public engagement with flood resilience agendas.

Second, multiple statutory agencies must take responsibility for raising awareness of the contribution FRe can make to broader flood risk management systems. Simultaneously, there is a need for a clearer delineation of responsibilities for the uptake of FRe to improve public trust in the use of such technology. This can be supported by cost/benefit analyses for stakeholders, laying the potential for technologies to be embedded within the risk-pricing models of insurers. Capacity building can, and should, be supported by professional organisations through training and continuing professional development programmes.

Third, a number of measures should be pursued to underwrite trust in flood resilience products and the sector more generally. This includes the continued collection, clear communication and, where appropriate, the sharing of accurate data for risk assessments. FRe products should be presented in a way that allows decision makers and end users to easily compare their performance and appropriateness. This should be combined with the continued sharing of good practice on surveying and installing FRe features. Responsibility for operation and maintenance of FRe should be negotiated and articulated clearly and transparently. Finally, social equity issues must be taken into account. Where capacity to install FRe is found to be lacking (if certain sectors of society are less able to install, maintain and use products), action should be taken to address these circumstances. Where necessary, support should be provided for all to benefit from the potential of FRe technology.

Contents

1 Background – the Integration of Flood Resilient Tools, Technologies and Systems

1.1 Introduction

Flooding can no longer be mitigated solely by 'holding back' water through large-scale civil engineering schemes. Climate change, intensifying extreme weather events, burgeoning populations, escalating urban development, aging infrastructures and significantly altered responsibilities for risk governance and public administration all point to a requirement for new means of managing flood risk (European Environment Agency 2012). The momentum for more holistic strategies of *flood risk management* (e.g. Szöllösi-Nagy and Zevenbergen 2005; Schanze, Zeman and Marsalek 2006) has led to an acknowledgement that comprehensive flood risk management strategies must include the integration of flood resilient[1] (FRe) tools, technologies and systems. The implementation of such innovations can limit flood damage and hasten the recovery of people and places in the wake of water inundation. However, despite the increasing recognition of the value of receptor level technologies in creating greater resilience across Europe (White et al. 2011), their *comprehensive* integration into flood risk management remains elusive.

The findings presented in this final report (SMARTeST Project Deliverable 5.3) combines research across SMARTeST research teams and work undertaken as part of an earlier Project report on the 'Principles of Integration' (SMARTeST Project Deliverable 5.1) and the workshops and participatory planning sessions used to assess the implementation tools in case study areas (SMARTeST Project Deliverable 5.2.). This report proposes practical strategies that will support the realisation of flood resilient technologies into properties and communities across divergent national and regional contexts. Furthermore, the report presents a series of recommendations to improve the uptake of FRe across the EU and beyond.

1.2 Background to SMARTeST

The SMARTeST Project develops and disseminates knowledge to help facilitate flood resilience across Europe. It identifies challenges to the design and integration of FRe technologies and isolates opportunities for their promotion. Specifically, the Project is designed to improve the road to market for FRe technologies, particularly those with innovative or 'smart' features. These features rely less upon human intervention for their deployment, although correct use, installation and maintenance are critical to improving their overall effectiveness. Beyond innovative technologies, the project is also developing FRe modelling and decision-making, again with an ultimate aspiration to promote the growth of more resilient societies.

The project will achieve these aims by:

- progressing the design of holistic flood defence systems;

[1] The SMARTeST Glossary definition of flood resilience is "The ability to cope with flooding and the ability to recover from flooding" (Lawson et al. 2011). FRe technologies are, therefore, technologies that provide resilience to flooding, e.g. technologies with the ability to resist flooding and to enable protection to/ from flooding. This can refer to 'wet proofing' methods in which water is allowed to enter a building that has been constructed or retrofitted to minimise internal damage. FRe technologies can also refer to 'dry proofing' methods that aim to protect buildings from flooding. These technologies include barriers, protection walls and flood mitigation products.

- exploring 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 water'.

1.3 Integration of flood resilient technologies, tools and systems

This research report draws upon the theoretical insights and practical research throughout the SMARTeST project, with a view to demonstrating how FRe technology, systems and tools can be delivered in practice. This assessment report is the culmination of several strands of work across the project. It includes best practice examples of strategic and local planning to achieve integrative flood risk management by making the most effective use of FRe technology, systems and implementation tools. A brief review of previous reports that are critical to this final report are outlined below to help establish the context for this assessment report.

1.3.1 FRe Integration

An earlier SMARTeST report – 'Principles of Integration' was delivered to the European Commission in June 2011, project month 18 (White *et al.* 2011). It outlined strategies for *achieving beneficial synergies* internally – raising awareness of the need to achieve multiple benefits from SMARTeST research partners. Moreover, it looked at *enabling implementation* externally in order to secure FRe in practice. Through a literature review, conceptual framing, the co-ordination of a cross-national policy and practice review (named 'National Reviews'), and empirical work conducted through workshops, focus groups and interviews, this initial report established that the use of FRe differs greatly across the EU, varying according to the influence of regulatory, financial and cultural circumstances. Consequently, integration was identified to be a *process* rather than a finite end-state. The report also highlighted a number of barriers that inhibit the potential of FRe to play a stronger role in Flood Risk Management (FRM).

1.3.2 FRe Implementation

Building upon the findings of the report outlining the principles of integration, the research team coordinated workshops and participatory planning sessions that were designed to explore the use of FRe in the case study areas at both the strategic (professional) and local (community) scales (White *et al*, 2012).

The workshops were a critical element of SMARTeST, helping the team understand the road to market across the European Union and providing an opportunity to test the outputs emerging from other elements of the research project. The overarching aim was to gather information on the opportunities for and the constraints to, the uptake of FRe and its contribution to FRM. Each case study partner held two workshops to gain feedback for FRe tools, technologies and systems stakeholders. Local level workshops included the general public and householders while strategic level workshops mainly consisted of decision-makers.

Comparable data was generated across the national research teams through the use of common templates and frameworks for analysis devised by the team at the University of Manchester. Section 2 of an earlier report (White et al. 2012: 9-15) provides further information regarding the methodological and practical co-ordination of the case study workshops, while the appendices outline the evidence base and provide an initial analysis (White *et al.* 2012: 20-55). This report builds on this analysis and provides best practice guidance to help improve FRe uptake through an analysis of the opportunities and constraints that face the sector.

1.3.3 Report structure

The remainder of this report establishes a context for understanding the principles and procedures that will underwrite the integration of flood resilient technology into businesses and communities throughout Europe. Chapter Two details the conceptual and methodological basis of the research and presents a framework for further understanding the issue of integration. Chapter Three provides a brief summary of the empirical data from which the best practice examples were derived. Chapter Four identifies a series of principles – awareness, acceptance and action – that can underline the more comprehensive integration of flood resilient technology into flood risk management systems. Chapter Five, provides a series of more detailed recommendations regarding the road to market for flood resilient technologies, systems and tools. The Appendices provide further details regarding the methods employed throughout the study. The team has also worked with stakeholders in England to draft two guidance documents, one aimed at a professional audience and another for the purposes of the general public. The two draft guides are included in Appendix 3. These were launched in the UK in June 2013, with the help of the National Flood Forum, a charitable organisation that represents flood victims. Though the documents are specifically applicable to the English context, with modification to account for particular regional and national contexts these guidance documents (and the principles they entail) may be applicable to other EU member states. Appendix 2 reviews the methodology used to support this.

2 Integrating flood resilient technology – conceptual and methodological contexts

2.1 Introduction

This chapter describes the analytical and methodological processes undertaken during the development of this research report. It first briefly references insights identified in in earlier research reports (White et al., 2011; 2012). The overall aim is to isolate and highlight the *opportunities* for flood resilient technology uptake across spatial scales. These form the basis for development of good practice for the integration of flood resilient technologies, systems and tools, and to highlight recommendations to support the 'road to market' for FRe.

2.2 The context of FRe integration– a framework for analysis

"Getting a new idea adopted, even when it has obvious advantages, is difficult" (Rogers, 2003: 1). Many innovations require a lengthy period, often many years, from emergence to when they may be considered as widely adopted, or 'normalised'. Previous research activities found considerable differences between integrating flood risk management at a strategic level, on the one hand, and local delivery mechanisms on the other. Earlier reports both detailed the multitude of influences affecting the uptake of flood resilient technologies White *et al.*, 2011; 2012). These are greatly dependent upon national, institutional, socio-economic, local and other drivers and contexts. For instance, one report reviewed the context for the integration of innovative and emergent flood resilient technologies into broader strategies and policies of flood risk (White et al. 2011). The report stated that such technologies encounter serious challenges to normalisation across a number of themes, and at several junctures during the development and marketing of flood resilient technology. Given the complexity of both the FRe technological innovation process and the intricacies of the broader administrative, managerial, cultural and economic contexts of flood risk management, a series of analytical frameworks have been developed to assist the research (summarised in full in White *et al.*, 2011).

2.2.1 Flood resilient technology – from concept to practice

Given this context, to appreciate the forces influencing the utilisation of FRe, there is a need to identify the 'road to market' for flood protection technology; that is the pathway from idea conception (including research and development) to instances when products are widely available for use, and are accepted to be so. The research team identified a series of conceptual themes to be investigated throughout the case study workshops. These were then summarised as encompassing three inter-related phases: Awareness; Acceptance; and Action (see figure 2.1).

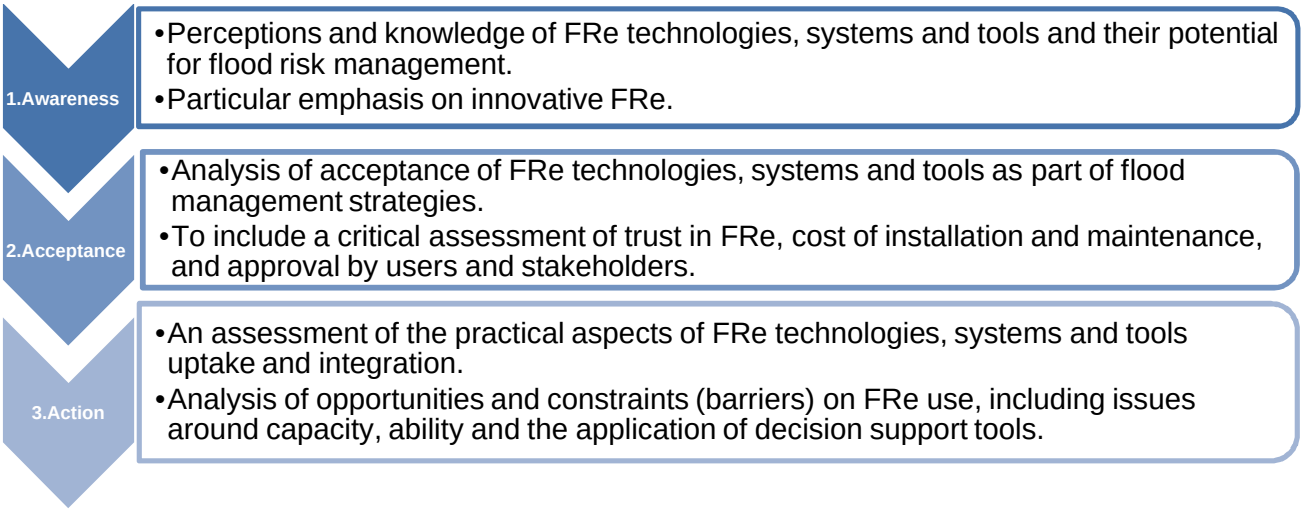

Figure 2.1 – Summary of workshop themes

2.2.2 Case study workshops

The SMARTeST project required "workshops and participatory planning sessions to use and assess the implementation tools in the case study areas" (White *et al.* 2012: 9). The workshops were informed by the outputs of other elements of the SMARTeST Project. Two workshops were planned for each SMARTeST participant country: one at the local level (for instance in neighbourhoods/ communities) and a second at a strategic (decision-making/ professional) level. The University of Manchester team took responsibility for co-ordinating the workshops across SMARTeST teams. Designed to be interactive, the workshops generated feedback regarding both the appropriateness of technologies, systems and tools, and the scope for their improvement. Although a degree of discretion was exercised by partners in the implementation of the workshops, adherence to a series of themes and a common workshop structure and style permitted internal integration and ensured comparability across diverse localities and national contexts.

Ultimately the aim of each workshop was to investigate and improve the road to market of innovative FRe, particularly the awareness of innovative flood risk management techniques, the acceptance of technologies, systems and tools by all stakeholders and the ability of actors to take action for FRe implementation. Combined, therefore, the themes would examine the road to market of FRe technology in its entirety.

The SMARTeST case studies were located in established urban areas. Most locations have experienced rapid urban development from the mid-20th century. Across the case studies, all types of flood hazard (coastal, river, pluvial, groundwater, flash) are represented and each highlights variable traditional responses to the prevailing flood-type, as follows:

- Coastal flooding – previous protection provided by a wall and the slope of the seashore promenade (Pathos);
- Pluvial flooding - sewer and drainage networks (Heywood, Rotterdam, Pathos, Villecresnes, Jouy-en-Josas) - retention basins (Rotterdam, Jouy-en-Josas) and through some property-level flood resilient protection (Heywood, Dresden);

- Fluvial flooding - traditional river bed work, retention basins and dykes (Jouy-en-Josas, Athens, Dresden, Hamburg) - dams and re-routing of established river channels (Valencia);
- Groundwater flooding - a well and ground water pumps (Dresden);
- Flash flooding - storm tanks and engineered retention systems (Valencia).

Although these 'traditional approaches' to flood management have afforded a degree of mitigation against flooding, none of the measures on their own will protect against all predicted future flood events across the case study areas. Indeed, several areas have suffered from flooding recently. Flood risk professionals, managers and regulators across the EU are increasingly accepting that cost-effective flood risk management can only be achieved by integrating FRe technologies into their current flood risk management systems. Yet the case studies demonstrated that most stakeholders lack information on FRe and that the FRe manufacturing sector, which is still in its infancy, lacks market penetration. Findings were cross-referenced through engagement with project National Support Groups in each participant country. This initial analysis provided a framework to assist the project team in preparing for the local and strategic workshops.

2.3 Conclusion

Across the project, evidence has been collated to understand: stakeholder knowledge and *awareness* of FRe; their *acceptance* of FRe; and *actions* required for integrating FRe into the flood risk management system. The evidence is also analysed according to whether the insights came from the property owners and local communities (local level stakeholders) or flood risk management professionals (strategic level stakeholders). As detailed in an earlier report, this approach is 'specifically designed to allocate attention...and facilitate change and may be considered as a heuristic device to analyse FRe opportunities and difficulties' (White *et al*. 2011: 31).

Ultimately, these analytical and conceptual frames of reference help to isolate and tailor the final recommendations to encourage innovation, to promote the wide scale diffusion of FRe innovations, and to support the capacity, skills and knowledge needed for effective uptake and management of these systems at *both* local and strategic levels of decision-making (see Chapter 5 for further details of the main findings). Chapter 3 integrates the data from the stakeholder workshops using a series of categories in order to fully account for the social and technical forces that influence innovation. For each theme, a detailed analysis of the *threats* to and *opportunities* for the integration of FRe was conducted to help provide a comprehensive picture of the strengths that could be capitalised upon and weaknesses to be addressed (similar to the synthesised approach undertaken for FORSEE Project, 2012). Further details on these themes are provided elsewhere (White *et al.* 2012). After these core themes were isolated, they were further analysed through the lens of the analytical model outlined above in Figure 2.1 (see Chapter 4 for a full discussion of these).

3 The integration of flood resilience measures at local and strategic levels

3.1 Introduction

As identified throughout other SMARTeST outputs, the reduction of vulnerability is fundamental to the provision of flood resilience. Although the workshops identified that flood resilience technologies are increasingly acknowledged to be integral to broader systems of flood management, their universal awareness and acceptance has yet to be fully realised. This section summarises the varied contexts for the integration of flood resilient technologies by reflecting upon the main insights and findings emerging from the SMARTeST project workshops. Combined, these findings have contributed to the identification of recommendations that will help support the wider use of flood protection technology.

3.2 Technological considerations

Workshop participants reported deep concerns regarding the performance of FRe technologies, undermining stakeholder and public confidence in their use. This is further compromised by the patchiness of precise data regarding hazards: potential users of FRe are unlikely to accept a product because of a misunderstanding of the risks they face. For instance, in all workshops concern was expressed regarding the accuracy of the forecasting and mapping of flood risk, particularly concerning the threat from pluvial flooding. Accurate flood assessments were identified as a critical to raise awareness of risk, to ensure risk is accepted by those most exposed, and as fundamental to taking action to mitigate and adapt to that risk.

It was reported that knowledge of small scale flood protection technologies was almost unknown (this was particularly the case in the workshops in Cyprus, Greece, Spain, and the Netherlands). That said, most workshops reported that awareness of FRe technologies is gradually increasing and that they are tentatively becoming accepted as an important component of broader flood risk management systems (UK and France). Across all the workshops it was acknowledged that further guidance to support community and citizens' decision-making is required as a matter of urgency. Information regarding the technical parameters of products, and how they may be integrated into broader flood risk management systems, was identified as being particularly pertinent. This could take the form of guidance concerning both flood resilient *materials* and of flood resilient *building* design, as explored throughout other aspects of the research that examine technical aspects of flood resilience. Table 3.1 summarises findings related to the technological parameters and effectiveness of FRe.

During the local and strategic workshops, SMARTeST team members presented examples and demonstrations of flood resilient technologies for use at property level, such as door guards and other aperture barriers, as well as community level interventions, including perimeter barriers and drainage improvements. Teams asked for feedback regarding the technologies from workshop participants from practical and aesthetic perspectives. A summary of this (particularly strengths and weaknesses) are provided in Table 3.2.

Workshops identified a degree of uncertainty regarding the acceptability of flood protection technologies. Workshops held with local citizens in France and in Germany reported that simple technologies (such as pumps and even sandbags) were favoured over 'smart' or complex technologies. Such concerns are amplified when efforts are made to understand how technologies may be up-scaled across communities

and neighbourhoods (the UK and France). Though, theoretically, use at a community scale may provide a greater degree of protection, and may be more reliable if used and maintained correctly, the greater complexity inherent within such arrangements can lead to greater uncertainty regarding any scheme's effectiveness. The aesthetics and visibility of technologies were identified as important factors affecting uptake (Cyprus, the UK), suggesting that in some instances, citizens have not installed technology if they contrast with the fabric of their property, or if they 'advertise' that a property is at risk of flooding.

It was further acknowledged that attention should be drawn to how such technologies perform within the context of broader systems of flood management. To facilitate this, it is critical to anticipate the overall effect of both property level and peripheral level resistance measures, not least through a consideration of the following questions:

- What is the effect of the particular FRe measure on the functioning of the wider flood risk management system?
- What are the consequences of FRe measures that are not installed correctly or that fail?
- What are the neighbouring and downstream consequences of the FRe measure(s)?

3.2.1 Regulatory and legislative factors

The practical integration of flood resilient measures must take place against complex administrative and bureaucratic contexts (White *et al.*, 2011). Given the application of the principle of subsidiarity for governance across the European Union, the integration of flood resilient technology varies greatly across territories and even *within* countries. Against this context, Table 3.3 summarises regulatory and legislative factors identified throughout the project.

No country possesses a coherent regulatory framework for the integration of FRe technology and for innovation. This was considered to have critical implications for perceptions of FRe; few communities and stakeholders felt able to place trust in FRe technologies not least given the currently opaque lines of responsibility for ensuring properties were flood resilient. That said, workshop participants identified an increasing momentum for further regulations regarding the integration of flood resilient technology, particularly for properties at risk of pluvial flooding (UK and Germany).

A potentially critical driver for the more comprehensive uptake of flood resilient technologies could be the *European Union Floods Directive*. The Directive requires that flood risk management authorities in all member states must create draft integrated flood risk management plans. These should include preliminary flood risk reports and maps, and flood hazard and flood risk maps in all areas where there is an actual, or potential, risk of flooding. These plans advocate a focus on prevention, protection, and preparedness, in addition to more effective emergency responses and recovery plans (EU, 2007). There is a tentative assumption across several workshops that the increasing accuracy of risk assessments may facilitate an increased uptake of FRe features. There are other administrative and legislative drivers for flood resilient technologies. In the UK, for example, the 2010 *Flood and Water Management Act* established Regional Flood and Coastal Committees who have the ability to agree local levies (paid by local authorities) to pay for works which do not attract a sufficiently high priority for funding by national government, but are nonetheless cost effective and of local importance. Yet such measures must be supported by excellent local understanding of flood risk on the part of managers, decision-makers, surveyors, designers and builders. Even these stakeholders, though, lack sufficient knowledge in the potential uses and application of

FRe, as referenced particularly in the UK workshops. In the SMARTeST partner countries there are no coherent and universally recognised best practice guidelines for manufacturers and installers, leading to a deficit of knowledge and trust on the part of communities.

3.3 Institutional

Institutional factors are summarised in Table 3.4. In a similar vein to regulatory and legislative factors, institutional fragmentation was identified as a significant barrier to co-ordinating FRe integration. This undermines the co-ordination of policies, strategies and support for FRe, and negates sector leadership and competitiveness. In many countries it was clear that the insurance sector had a defining role to play in the uptake of FRe. For instance, in Spain, a reliance on insurance compensation was identified as a disincentive to FRe installation and technological development. Similar sentiments have also been expressed in workshops in other countries, such as the UK and France, where either insurers or governmental initiatives have provided compensation in the wake of flooding. Such arrangements, though undoubtedly critical in providing societal resilience in a general sense, undermine clarity regarding responsibility for providing property level flood protection. Moreover, in the UK workshop participants suggested that insurers are primarily concerned with protection against fluvial flooding, at the expense of protection for pluvial flooding (which itself is becoming the greatest flood risk across the UK and throughout other European regions). It was suggested that, in the future, insurers might insist on the installation and use of FRe (and the regular maintenance of systems) *prior* to the provision of insurance cover, or for a reduction in insurance premiums or flood cover excesses.

3.4 Cultural

The FRe 'road to market' (including FRe innovation, diffusion and uptake) faces a number of barriers and constraints, perhaps even related to the entire premise and justification for FRe. There is a need to not just demonstrate the efficacy of new products, but also to overcome potentially deep reluctance of 'new actors' (in communities and across governance scales) to assume ownership of, and responsibility for, managing risk. Across the countries surveyed and several of the local and strategic workshops, there is a perception that flood defences should be provided by the state, a situation supported by the general lack of policies in support of FRe. Earlier research also confirmed a general lack of incentives by authorities, planners and the insurance industry to promote the development and the deployment of FRe (White *et al.*, 2011). Dominated by small and medium size companies (SMEs), the FRe industry reported constraints caused by high product development costs, by the public's lack of acceptance of risk and an associated dearth of responsibility to confront it, a deficit of knowledge regarding the effectiveness of flood resilient technologies, and by the cost and visual impact of some products, particularly in areas where 'listed' or heritage buildings are situated.

Moreover, previous research (White et al., 2011), in conjunction with the Project's workshops, highlights a flood 'mitigation culture' based on large scale structural interventions rather than 'living with floods'. This observation is equally applicable to communities and the public who similarly favour large scale flood mitigation schemes over smaller scale (receptor) adaptive technologies. For example, case studies throughout partner countries demonstrate that the preferred method of resilience (compatible with the majority of FRM systems in Europe) is to *waterproof* buildings; that is, to ensure properties are dry-proofed. Moreover, the case studies confirmed that technologies alone are insufficient to ensure full resilience. This underlined the importance of understanding human behaviour and the need for clear, accessible and effective guidance on flood resilience in general and on how to take advantage of flood resistance measures in particular.

3.5 Economic

Economic issues were considered to be critical to setting the context for flood resilient technology integration. Although FRe technology, correctly installed and used appropriately, is likely to reduce the costs of remediation in the wake of a flood, there is significant debate regarding the development of adequate forms of cost-benefit analysis upon which to base decisions. Additionally, workshop participants suggested that the issue of who funds technologies has a significant impact on framing the market for FRe.

3.6 Political

The responsibility for flooding, and for the installation of FRe, can be a matter of intense political debate throughout tiers of governance. It was agreed that the state should have a critical role to play in the support of FRe, and for establishing circumstances that are conducive to FRe technological innovation and practical integration. However, due to a marked 'retreat' of the state and strained public finances, it was recognised that the onus for FRe installation will in the future fall upon the immediate beneficiaries (that is, property owners). That said, there were specific cases where direct funding has been provided to support property level protection. For instance, in the United Kingdom annual Flood and Coastal Erosion Risk Management allocations use partnership funding to install flood protection in certain homes. In this instance, property owners are advised to contact local authorities or the Partnerships and Strategic Overview Team in their local Environment Agency office for support with this. A summary of these political considerations and associated political forces are summarised in table 3.7.

3.7 Social circumstances

Social issues can prove a significant factor that influences the uptake of FRe. Certain sectors of society possess less capacity and/or knowledge to respond to flood risk than others, whilst several technologies raised access and usability issues, for instance for elderly users, and people with mobility issues. In some workshops it was reported that participants are beginning to accept the need to pay for their own flood protection technologies (Greece). On other occasions, these social considerations were affiliated to concerns regarding the technological parameters of flood resilience features. For instance, it was clear throughout the workshops that citizens (and in many instances decision-makers and other stakeholders) lacked faith in the effectiveness of technologies. Workshop participants in France reported that there was no tolerance of devices that let even a relatively small amount of water breach properties. Similarly, there was a widespread recognition that citizens required much further support when considering options for flood protection. These are summarised in table 3.8.

Table 3.1 – Summary of threats and opportunities regarding the theme of *Technology* from the local and strategic workshops, 2012 (See Appendix 1 for more detail on the individual workshops)

Local		Strategic	
Threats - Public generally unaware of the range of technologies available. Public unaware of where to find further information regarding technical solutions and of the parameters within which such technologies operate. There is also an associated lack of trust in flood resilient technologies. - FRe products usually require professional installation and maintenance. Though this may generate further trust in technologies, the need for such expertise was identified as a major barrier to FRe integration. - The effectiveness of FRe technology can be compromised by the fabric of the building requiring protection. A thorough survey is usually required to gain maximum benefit from small scale technologies. - Non-automated technologies are reliant on adequate flood warning systems. These are not in place in many contexts. - The requirement, method and responsibility for on-going product maintenance need to be more clearly defined.	***Opportunities*** - Many workshops reported that awareness of FRe technologies was *gradually* increasing; they are (tentatively) becoming accepted as an important component of FRM. However, it was acknowledged that further guidance to support community and citizen decision-making is essential. - Automated technologies, negating the room for human error, would help build faith in the sector, but more innovation and testing is required. There is also limited knowledge of these technologies.	***Threats*** - Decision-makers were generally aware of flood resilient technologies, yet lacked an appreciation of the range of technologies available and their design parameters. - Despite awareness, many stakeholders reported a lack of trust in flood resilient technology. Non-automated technologies are reliant on adequate flood warning systems which are not in place in many contexts. - Concerns regarding the perceived inadequacy of surveys and consultations were raised, highlighting this as a critical stage in the FRe integration process. - Local flood risk assessments are far from comprehensive in many EU countries. This is proving to be a barrier for the integration of appropriate technologies into broader FRM strategies. - Project partners reported that testing regimes across Europe are divergent. Efforts to co-ordinate/ converge these across national contexts would be welcomed. Guarantees that technologies will work are rare.	***Opportunities*** - Many stakeholders reported that the awareness of FRe technologies was improving. There was an associated realisation of their potential contribution to flood risk management systems was developing. However, mirroring perceptions of communities, it was agreed that further guidance/ certification was necessary to underwrite this. - Technological improvements to FRe, (for instance more reliable automation, relative ease of maintenance, and the potentially rapid proliferation of technology (compared to large scale flood defences)), was enhancing FRe uptake. - Given increases in pluvial flooding (constituting 75% of the losses incurred by one large UK insurance company in 2007), FRe is emerging as the most viable form of protection in many instances.

Table 3.2: FRe products at property and community level: strengths and weaknesses.
Information from the local and strategic workshops, 2012 (See Appendix 1 for more detail on the individual workshops)

Option 1 – Property level, aperture barriers, building technology and back flow valves	
STRENGTHS - Simple technology that is readily understood. - 'Fit and forget' options. - New technologies can be easily incorporated into systems. - Low cost, especially when publicly funded or provided through shared funding. - Approach is suitable for low depth, low flow and short duration floods. - Third party certified products are available in certain EU markets.	**WEAKNESSES** - Often best placed for use at low depth floods, therefore, may be overtopped. - Poor installation reduces performance and results in leakage. - Insufficient attention paid to who will install or operate products (if required) during a flood. - Failure to fit in advance of flood (for instance, if there is no flood warning). - Lack of willingness of owners/ local government to 'adopt' solutions. - Non-system (one-off or bespoke) approaches may unbalance the system.
Option 2 – Community level, perimeter and infrastructure barriers	
STRENGTHS - Prevents the need to deal with each property individually – up-scaling. - There could be greater opportunities to lobby for community wide protection.	**WEAKNESSES** - Uncertainty over effectiveness of the partnership between local population and local government which is often required to operate system effectively. - Uncertainty regarding how the technology will work in flood conditions. - Insufficient time to install technology, no warning system in place. - Not all properties need FRe technology and rely upon co-operation between adjacent property owners.

Table 3.3 – Summary of threats and opportunities for FRe regarding the *Regulatory* theme. Information from the local and strategic workshops, 2012 (See Appendix 1 for details)

Local		**Strategic**	
Threats	***Opportunities***	***Threats***	***Opportunities***
- Communities highlighted the lack of coherent regulatory frameworks or technological standardisation procedures. This was considered to severely erode trust in FRe. - In a minority of cases, the installation of FRe requires further regulatory permissions (for instance due to planning or safety restrictions). This may prove to be a further barrier to FRe uptake.	- The EU Floods Directive is leading to improved flood risk assessments, which may increase FRe technology uptake. The Directive may also lead to further acknowledgement of the contribution of FRe systems/ models to FRM. - The public expressed support for further tightening of the regulatory regime for FRe installation. It was reported that accreditation may increase their confidence in technologies. - Developmental pressure could lead to further construction on flood plains. Although this was criticised in workshops, this may prove to be a driver for the uptake of small scale FRe.	- Workshops reported few coherent regulatory frameworks or standards for FRe in most countries. Even where regulation exists, stipulations may not be consistently applied or enforced across territories or sectors. - Regulations must be compatible across sectors (for instance do not contradict safety legislation and are sustainable) and coherent across scales (that is, transferable across Europe). - Although many stakeholders reported support for further regulations and standardisation, it was acknowledged that there is no current political appetite for regulation. - Some workshop participants (and NSGs) noted that standardisation may limit innovation by establishing a low standard.	- Further regulations were viewed by the vast majority of research participants as critical for ensuring stakeholders (including the public and insurers) could have confidence that FRe would work. - In several workshops, stakeholders reported they would welcome independent, voluntary guidance to help the FRe sector become more transparent and to support the sector's maturation. - Flooding is increasingly recognised as a health and safety issue which needs to be addressed by the authorities. - Stakeholders agreed that FRe could become a mandatory requirement for new build across the EU. - FRe has significant potential to become part of state funded flood risk management systems.

Table 3.4: Summary of threats and opportunities on the theme of Institutional factors Information from the local and strategic workshops, 2012(See Appendix 1 for more detail on the individual workshops).

Local		**Strategic**	
Threats	***Opportunities***	***Threats***	***Opportunities***
- Members of the public reported a lack of clarity regarding the responsibilities for FRe integration. There is further confusion regarding who is responsible when FRe fails or is overwhelmed. - Local area flood risk assessment is still relatively poor in many EU countries – this is proving to be a barrier for the integration of appropriate technologies into flood risk management systems. - In countries where insurance regimes were a major stakeholder, citizens suggested that principles of 'no betterment' were a major constraint to the uptake of FRe.	- In the UK it was suggested that the insurance sector is increasingly interested in supporting FRe uptake.	- Multi-agency involvement (and institutional fragmentation) in flood risk management undermines the cohesiveness of strategies to support FRe integration and product road to market. - Insurers reported a reticence to accept the effectiveness of FRe requiring human intervention. Such technologies were considered to be unreliable. - There was a perception that institutions did little to support innovation and product development over the course of the 'road to market'.	- It was reported that FRe could become a requirement by mortgage providers and insurers. This may 'force' the uptake of FRe assisting its normalisation across society.

Table 3.5: Summary of threats and opportunities relating to regulatory and legislative considerations - Information from the local and strategic workshops, 2012 (See Appendix 1 for more detail on the individual workshops).

Local		**Strategic**	
Threats	***Opportunities***	***Threats***	***Opportunities***
- There is a degree of resistance (and a lack of informed knowledge) regarding the principle of FRe technologies. Beyond this, there was a sense on the part of the public that institutions should take responsibility for managing flood risk. - The recent emergence of FRe technology has led it to be thought of as untried and untested, undermining feelings of trust in the technology. There is also a general lack of knowledge regarding flood risk. - Stakeholders observed the public often do not install FRe *even* after a flood. The use of flood ratios and the description of flooding as unprecedented or 'freak' further undermine understanding and acceptance of flood risk. - Many people are not aware they are at flood risk, and many of those that believe they can't be protected using FRe. There is a lack of education regarding FRe and its potential to help people live resiliently. Memories of past flood events are short. - Property level FRe is virtually unknown in many countries across Southern Europe. - FRe must not only work in order to be acceptable to the public, but must also be unobtrusive, aesthetically pleasing, and user-friendly.	- In workshops citizens increasingly acknowledge that FRe technology does have a role to play in broader efforts to secure flood risk management. - Citizens welcomed innovations that improve the aesthetical appearance of FRe, or that help FRe become less physically and visually intrusive.	- There is a degree of resistance (and a lack of informed knowledge) regarding FRe technologies, even amongst many decision-makers and stakeholders. - Insurers in particular feel that flooding should be confronted at source or pathway. This undermines efforts to normalise FRe against the context of the 'living with water' policy agenda.	- It was acknowledged by decision-makers that smart (automatic) FRe that does not require human intervention may be more acceptable to the public - Many stakeholders reported that after a major flood event, there would be heightened public awareness of the need to assume ownership of risk.

Table 3.6 – Threats and opportunities identified for the Economic theme. Information from the local and strategic workshops, 2012 (See Appendix 1 for more detail on the individual workshops)

Local		**Strategic**	
Threats	***Opportunities***	***Threats***	***Opportunities***
- The cost of FRe installation to property owners is relatively high compared with the perceived risk. Communities noted that analyses of the benefits of FRe must become much more sophisticated - It was suggested that such technologies, though critical to managing risk, were rarely considered an economic investment, and may even undermine property values. - Given public spending cuts across the EU, and the economic downturn, there is limited funding available for FRe. There is also a lack of financial incentives for FRe (e.g. reduction in insurance premiums).	- Climate change and urbanisation are increasing the risk of flood throughout the EU and are stimulating the market for FRe. - Post-flood remedial work is much more expensive than embedding resilience in the first place	- From a product road to market perspective, FRe manufacturers are predominantly SMEs with low research and development budgets. This is under further pressure from the effects of the economic downturn. - The high cost of product testing and world-wide patenting limits research and development of FRe - Decision making would be supported through a thorough cost-benefit analysis of flood systems, and an acknowledgement of how a technology integrates with these systems. - Partnerships and collaborations will be increasingly required to piece together flood protection schemes. However, these face significant governance challenges, often require delicate compromises that partners are not necessarily ready to agree to, as well as sometimes lacking the benefit of strategic oversight.	- FRe remains a young, vigorous and entrepreneurial industry. There is scope for significant innovation, and stakeholders believed the sector has the potential for significant development in the future. - FRe technology is a cost effective method for increasing protection against flooding. - There is an increasing level of realisation that remedial work on flooded properties is many times more expensive than embedding resilience and resistance measures in the first place. - Maintenance of FRe is relatively inexpensive.

Table 3.7: Summary of threats and opportunities for innovative FRe on the theme of political factors Information from the local and strategic workshops, 2012 (See Appendix 1 for more detail on the individual workshops).

Local		**Strategic**	
Threats	***Opportunities***	***Threats***	***Opportunities***
- There is a general lack of state aid for research and development for FRe. However, the public in most EU countries look to the state or insurers to protect them. - Communities acknowledged that in times of state retreat, flood defences would be just one of a number of pressing themes vying for political attention. - Responsibility for flood risk management and FRe is *fragmented*, in *flux* and often is confusing – particularly to the public.	- Recent floods across European countries have increased the political profile of flooding as an environmental hazard. - It was acknowledged that some communities, particularly in wealthy areas, are effective at lobbying for flood alleviation schemes including FRe technology.	- The nation-state is no longer the dominant stakeholder in flood risk management, necessitating (or forcing) actors both 'beyond' and 'below' the nation-state to implement FRe. - In several EU countries the state is the insurer of last resort (France, Spain) and this compromises the uptake of FRe. -The transposition of the Floods Directive and a gradual harmonisation of FRM across the EU requires discrepancies and fragmentation to be confronted.	- The 'localisation' agenda in many EU countries will enhance the need for 'local' protection measures and thus the development of FRe. - The increased onus on communities and the public to implement FRe was viewed by some stakeholders as a potentially important driver for FRe implementation - Governmental agencies are well-placed to promote FRe.

Table 3.8: Summary of threats and opportunities for FRe in relation to societal circumstances - Information from the local and strategic workshops, 2012 (See Appendix 1 for more detail on the individual workshops).

Local		**Strategic**	
Threats	***Opportunities***	***Threats***	***Opportunities***
- There is a general lack of awareness of flood risk, and thus of FRe, in communities across all workshops. - Many vulnerable sectors of society lack insurance and will only benefit from FRe if it is provided by the state. These same sectors of society are unable to effectively lobby authorities for increased protection, and may be unable to pay for the installation of FRe independently. - Other groups of people (disabled, elderly etc.) may be less well placed to install FRe and on a practical level may be physically unable to activate technologies (unless they are automated). - Social housing tenants and landlords are particularly 'hard to reach' for FRe uptake. -Some property owners are reluctant to use/ install FRe for aesthetic reasons, or because it may cause blight or prevent them from obtaining insurance. - Some products such as temporary flood gates can require a high level of community involvement which can also be unreliable	- Several partners reported that the public are increasingly being made aware of FRe by local flood victim relief forums and community self-help groups. - Community or advocacy groups may be able to facilitate schemes across a wider scale and can support the activation of FRe in the immediate threat of a flood. However, there are challenges to this, particularly in low income or urban areas.	- Some stakeholders referred to issues pertaining to the equity of FRe access. It was acknowledged that many in society are less well placed to be able to use flood resilient technology.	- Community and victim support groups are well-placed to feed into the research and development agenda. - In many EU countries there is a societal shift towards an agenda of 'living with risk' and 'living with water'. - The retreat of the state in active FRM and the move towards localism is leading to enhanced civil awareness and is placing the onus on property owners to take action. - The use of FRe products such as barriers is enhanced by neighbour (community) wide projects. - The public are increasingly being made aware of FRe by many agencies dealing with FRM and with national and local flood victim relief forums.

4 Supporting The Road to Market for FRe

4.1 Introduction

There are many complex issues involved in the investigation of the potential of FRe technologies and their place in the delivery of integrated FRM (that is, the road to market for FRe). As detailed throughout Chapter 3, it is vital to consider responses to these issues both by local stakeholders (the general public and communities) and strategic stakeholders (flood risk management professionals). By way of summarising this analysis, the cross-sectional conceptual themes are identified in terms of how the awareness of innovative FRe, the acceptance of FRe by stakeholders, and subsequently to the ability of all actors to take actions for implementation. Their variety suggests that, in order to contribute more fully to flood risk management strategies, there is a need for clarity and intervention regarding a host of issues. These would help promote awareness of FRe, the process by which they could be utilised and help promote good practice within the sector.

4.2 Awareness of FRe

The awareness of FRe across the EU seems to vary considerably. Generally, both decision-makers (including professionals) and the general public lack awareness of smart and innovative FRe, and are in broad agreement on the need for education and further information regarding the use of technology. Likewise, there was broad support for efforts to promote trust in products and their integration into broader society.

In northern countries (UK, Germany, France, the Netherlands) strategic stakeholders in flood risk management have a good idea of what type of FRe products are available whereas in southern Europe (Spain, Greece, Cyprus) knowledge of FRe is poor and it does not appear to have made any inroads into national FRM strategies. Whilst strategic stakeholders are aware of 'smart' automatic FRe measures, this knowledge does not extend across the general public in all countries surveyed. Also, in all countries in this survey, uptake is compromised amongst local and strategic stakeholders by concerns over the performance and the financing of FRe, on establishing quality control during installation, on how to ensure on-going maintenance and on the ability of the ultimate user to operate the products correctly and undertake maintenance. It was also noticeable that in those case studies where there a considerable length of time (circa 8 to 10 years and over) had passed since the last flood event; public awareness of flooding, in general, was considerably lower as was knowledge of the particular strategies that may be taken to counter flooding.

4.3 Acceptance of FRe

The most important element in establishing the level of vulnerability to the risk of flooding is through the flood risk assessment process. Unfortunately, in all countries surveyed there remains a general lack of confidence in existing flood risk assessments by all stakeholders and on the part of the public. The acceptance of FRe is also compromised by their lack of faith in the efficiency of weather warning systems to allow time for the deployment of non-automatic FRe products and systems. Barrier and perimeter technologies still gain a wide level of acceptance by the general public but there is a clear preference by flood risk professionals towards automated FRe if it is available, despite concerns over its ability to perform.

Local stakeholders appreciate the potential of all building level technologies to provide protection of their assets but harbour concerns over the practicality of these products, their aesthetics, their ease of use and their cost effectiveness. Furthermore there is a general lack of evidence in all countries of meaningful community initiatives and a firm belief by the public that Governments must be responsible for area wide protection against all types of flooding. However there does seem to be a high level of acceptance by homeowners that ultimately individuals do need to be responsible for protecting their own properties with the proviso that governmental agencies provide a substantial proportion of the funding for FRe measures.

4.4 Action in implementing FRe

In many EU countries it is becoming increasingly evident that state institutions alone are unable to provide robust protection against flooding. The potential cost/benefit of FRe to provide both property level protection and to contribute to the flood risk management system as a whole is now widely accepted and large institutions, infrastructure providers and individuals are increasingly recognising the advantages of using FRe measures. However, the wide-spread adoption of FRe requires a coordinated approach by the lead flood risk management agency to ensure that these measures are integrated into the overall flood risk management system. Such coordination is also required to ensure that disadvantaged members of the community also benefit from these measures and that FRe measures avoid creating unintentional impacts downstream. Yet, trust in the ability of FRe to perform effectively remains low and the general reluctance amongst flood risk management agencies, and crucially also by insurers, to recommend and to action the deployment of FRe still needs to be addressed. The reluctance of the insurance industry regardless of whether or not it is subsidised by the state, to recommend the use of property level FRe and to provide either finance for its implementation or reductions in premiums when it is installed by the property owner is of particular concern. Insurers argue that FRe measures might fail due to the potential unreliability of humans to operate them correctly and that the products might not be correctly installed or maintained. The development of robust, automatic and/or simple to use FRe measures is underway in an attempt to address this issue of trust. Independent verification of the efficiency of measures to provide added resistance will further enhance the uptake of FRe.

4.5 Towards Guidance

In terms of integrating FRe into the practice of planning and flood risk management, particularly where there is little regulation, previous research noted that it could not be conceived of as a final outcome or an end state to be achieved; instead it is an iterative process (White *et al.* 2011). Moreover, the differences between national governments in terms of their institutional structures and type of flood risk mean that the imposition of the EU Floods Directive would be far from even.

It became apparent from the stakeholder workshops that the UK is one of the leaders in innovative flood technologies for small-scale urban flooding, particularly at community and property level. This may be due to a £5.2m Government-funded initiative that stimulated the uptake of property level flood resilience measures that could act as ‘test’ cases. The scheme has been favourably judged and opportunities have been identified to build upon this scheme (Environment Agency/ JBA Consulting 2012). Consequently, as part of WP5, SMARTeST partners collaborated with a wide range of UK stakeholders (including governmental and local regulators and flood risk managers, FRe product manufacturers, community flood resilience forums and the general public) to develop good practice guidelines for both the general public and for strategic stakeholders. These guidelines are outlined in Appendix 3 and they show how FRe can be integrated into FRM in England.

Importantly, both guidance documents distil a process that may be more generally applicable. Best practice is presented as six sequential steps that cover the necessary steps from understanding the risk through to design and operation and maintenance. Though presented as a linear process, step 6 suggests a reassessment of the residual risk of flooding as well as continual reminders to the end-users of technology to maintain it, undertake drills and simulations to ensure its efficient operation, and to sign up to community wide flood support groups so that they can properly plan and prepare for all types of flood risk that may not be covered by the technologies. Other instances of good practice around FRe include requiring the beneficiaries of the measures to sign up to flood action groups, such as that in Buckingham (UK). Here, the networks of a well-established community group, Churches Together, were used in order to disseminate planning, preparing and responding to flood events. Once established, the flood action group assisted property owners in planning for and installing innovative FRe measures.

Although the guidance and principles forwarded as part of this report particularly pertain to the UK (or more specifically, England) the process is transferable to other national contexts. The methods used included the use of surveys, interviews and securing buy in. This could be replicated in other EU countries, within the parameters of the six steps shown in Figure 4.1, in order to ensure that they are culturally relevant to different member states. Furthermore, such guidance needs to be produced by an independent and trusted third-party. Adopters must fully complement developing technical testing and standards, yet similarly pay due attention to the ability of particular end-users to understand, deploy, and maintain the technologies.

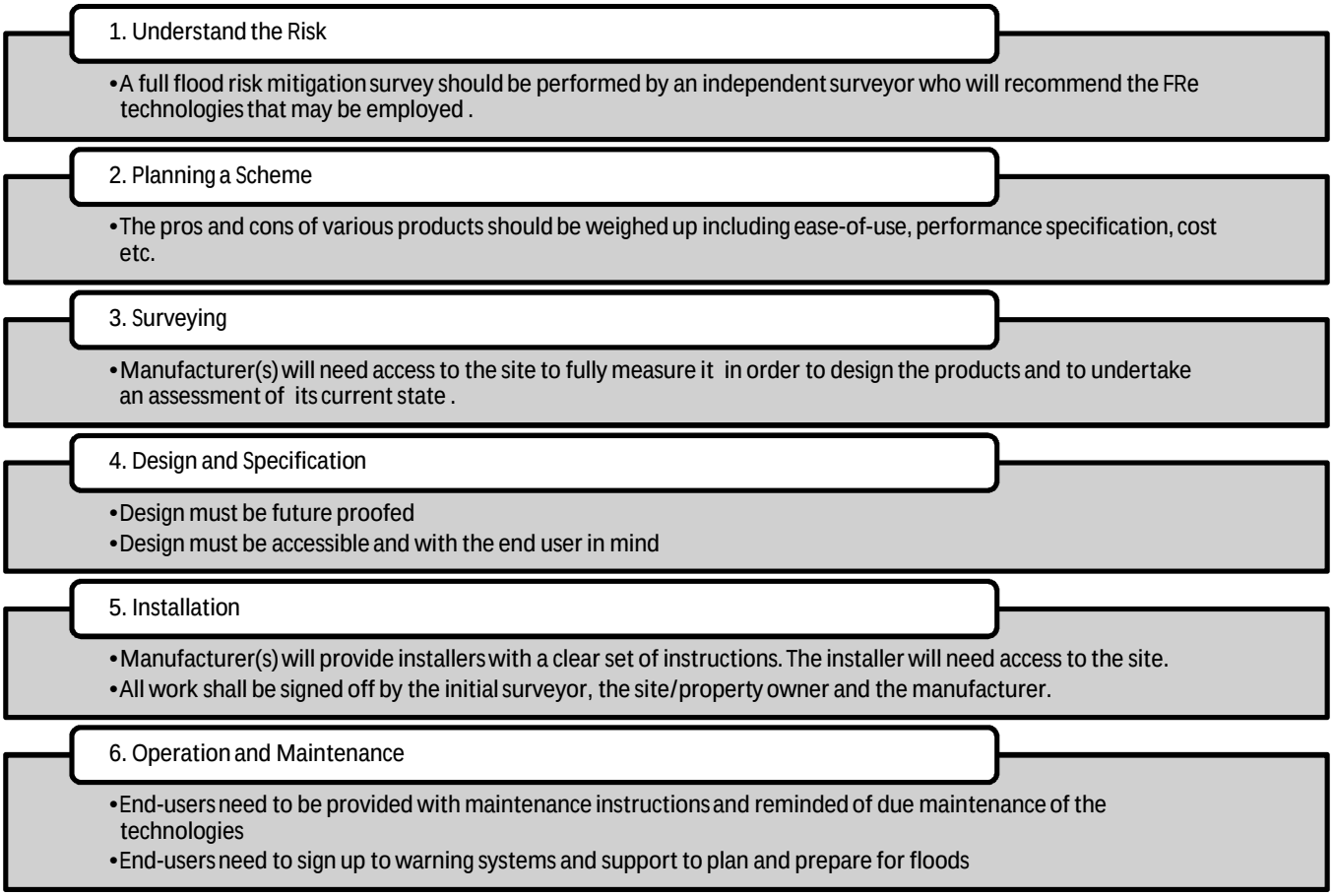

Figure 4.1 The Six Step Process to implementing FRe

5 Summary: The Road to Market of FRe

5.1 Introduction

This report has made reference to the case studies, workshops and extensive studies made by the SMARTeST project in providing an evidence base for the implementation of flood resilient products, tools and systems (FRe). It has assessed the strengths, weaknesses, opportunities and threats appertaining to issues affecting the uptake of FRe so that it can make a series of recommendations aimed at improving the uptake of FRe throughout the EU. These recommendations are addressed to all the flood risk management authorities/agencies across the EU in general and to certain sectors or agencies therein in particular. The recommendations are structured around the three stages of the 'Road to Market' introduced elsewhere (White *et al.*, 2011).

5.2 Research and Development

1. *Support*: Governments should promote FRe research and development (R & D) to facilitate an innovation friendly environment. The SMARTeST project has resulted in a series of innovations and the evidence from the stakeholder and local workshops indicates that more can be done to promote innovation through testing protocols.

2. The uptake of FRe is clearly hindered by convincing examples of FRe implementation. Successful examples will help to convince all stakeholders that new technologies are robust, trustworthy, easy to apply and maintain. Applications of examples through demonstration cases, supported by active dissemination and promotion, will provide a strong support to the uptake of FRe

3. *Testing*: Products need to go through robust testing regimes, agreed certification protocols with their performance independently verified.

4. *Transparency*: the operational parameters need to be communicated effectively to a variety of potential users. Guidance documents, as detailed in Section 4, can assist in integrating operational parameters with on-going flood risk management.

5. *Use-ability*: Products need to be aesthetically pleasing, easy to use for different users and to maintain.

6. *Stakeholder Involvement*: Key stakeholders, such as insurers and flood risk managers, need to be more actively involved in product development.

5.3 Promotion and Acceptance

1. *Awareness*: Need for greater awareness of how FRe can contribute to a FRM strategy. This could be done by multiple agencies such as the state, local flood risk management agencies, property owners/landlords and by financial stakeholders such as insurers.

2. *Responsibilities*: In order to gain the acceptance of FRe by the general public, flood risk management agencies need to make clear who is responsible for the uptake of FRe.

3. *Understanding*: FRe users, such as members of the public, need to understand how FRe can help them manage flooding. For example by guidance documents and through clear understanding of FRe performance.

4. *Cost And Benefits*: Stakeholders need to be clear on the costs and benefits of FRe, such as the impact upon the provision of insurance cover and how the change in risk may be priced.

5. *Capacity Building*: Training should be provided for requisite professionals, such as surveyors and built environment professionals, to understand and implement FRe.

6. Community Involvement: Local political leaders should promote community involvement in flood risk management within their neighbourhoods.

5.4 Implementation and Maintenance

1. *Risk Assessment*: There is a need for accurate data, including past events and local knowledge, to understand and map the risk to a locality and understand the ability of FRe to mitigate. This would be supported by increased sharing and integration of data.

2. *Comparability*: Decision makers need to be able to easily compare the performance of products to promote innovation, competition and consumer choice.

3. *System*: Where FRe is implemented on a community scale consideration needs to be given to the impact on the local area and the connectivity between buildings.

4. *Survey*: Products need to be appropriate for the risk to buildings, properly installed and their effect quantified. They also need to be appropriate for the user.

5. *Responsibility*: There is a need to be clear on who should pay for and maintain the products.

6. *Equity*: FRe should be affordable and accessible by socially vulnerable sectors. Funding regimes should also consider providing incentives for FRe, such as matched funding or others means to ensure social equity.

7. Deployment: Users need to understand how to fit and maintain the products, including how to access advice on flood warnings and when products may fail.

8. *Restoration*: The insurance industry should move towards incorporating FRe in buildings that are being restored after a flood event.

Taken together, these recommendations demonstrate the problems that may be experienced by an emergent sector, such as FRe. The variety of barriers and opportunities suggest that, in order to contribute more fully to flood risk management strategies there is a need for clarity on a host of issues. These would help promote awareness of FRe, the process by which they could be utilised and help promote good practice within the sector. *Accordingly, through stakeholder involvement and consultation, two guidance documents have been designed: one is aimed at a professional audience and another at the general public.* These two guides are included in Appendix 3. These will be launched in the UK in 2013, with the help of the National Flood Forum, a charitable organisation that represents flood victims.

5.5 Future Research

1. It is recommended that other EU countries use the Guidance Documents, outlined in Appendices 2 and 3, as a template to produce similar help for the FRe sector in their respective countries, and that the EU consider the possibility of adopting these on a European scale. The methodology for producing these guides is given in Appendix 2 of this document.

2. FRe products need to be transferable across EU countries. This would involve work at the EU level to consider harmonisation aspects such as testing protocols, product accreditation and clear responsibilities.

3. More research needs to be conducted from an EU perspective to examine the future role of FRe in a dynamic FRM system that has to cope with uncertainty due to future climate change and urbanisation.

4. Further investigations should also examine the cultural aspects of FRe in greater depth, such as the changing relationship between the state and market and on the increasing responsibility placed on different sections of society who previously assumed a negligible role in flood risk management.

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Appendix 1: Evidence Base

Road to Market for FRe - The evidence base

	UK	CYPRUS	FRANCE	GERMANY
Strategic awareness of FRe	- High awareness of risk but strategic action is a low priority of LA and other agencies - Good awareness of FRe. Concerns re 'how smart is smart' will it ensure resilience, trust in product, in installation and in maintenance and ownership of the problem.	- No awareness but interest in learning about FRe	- All scales are important in evaluating performance of the system as is knowledge of local flood problems. - Home-made barriers preferred over commercial in area frequently flooded and reluctance to use 'smart' technology. Like reliable, no-think, simple robust solutions.	- Pre 2002 low awareness a/c last flood in 1940's - Local FRe system is to mitigate physical damage to buildings. - Good awareness but constrained by lack of performance and cost/benefit data. Feeling certification would improve uptake.
	GREECE	**NETHERLANDS**	**SPAIN**	**WASHINGTON**
	- Only marginal awareness. Constraints re installation, maintenance, automation, use by elderly, cost/benefit and lack of performance data,	- No plans to use FRe - Low awareness of FRe	- FRe not common and hindered by lack of information.	- Need to improve awareness. Uptake hindered by lack of insurance incentives and good life cycle and cost/benefit analysis.

	UK	CYPRUS	FRANCE	GERMANY
Strategic acceptance of FRe	- FRe system should withstand leakage to 900mm depth over 4 hours, be installed at max one minute per linear metre, allow for 10 reuses over 10 years and have no downstream effects. - Problem is forewarning re pluvial flooding and ownership of risk. Also lack of expertise by planners. Concern regarding ability of Local Authorities to manage flood risk. Automated FRe preferred but concern re ability of technology.	- Reliable and prompt forecasting needed. - Need for cooperation between Government and insures to improve flood knowledge data base.	- Concern re weather forecasting and thus re vulnerability assessment.	- Structural measures insufficient to protect even against riverine flooding. - FRe needs to be part of risk assessment and forecasting is the key. EU flood directive might help.
	GREECE	**NETHERLANDS**	**SPAIN**	**WASHINGTON**
	- Concern re forecasting and experience and expertise of staff. EU directive might help by making flood maps available.	- No methods for pluvial risk assessment and mapping. Better rainfall forecasting and data sharing is required.	- Acceptance that FRe, linked to other FRM systems, could substantially reduce flood damage but systems/products must be linked. Also management systems must include capacity building. - Lack of confidence in risk assessment but EU Flood Directive should help.	- Flood risk mapping generally accepted.

	UK	CYPRUS	FRANCE	GERMANY
Strategic action on FRe	- FRe compromised by lack of knowledge and finance by statutory agencies. - Movement towards people managing their own risk but concern regarding their capacity to do so. - Insurers wary of FRe. - Feeling that FRe should be part of FRM decision making process. - Risk assessment requires local knowledge. - Good practice guidance and product certification needed 2.2. - Need for data and local skills to integrate decision support tools into existing systems. - Needs coordinated liaison and system to generate trust. - Insurers identified as key actors.	- Challenging when no FRe products are available 'of the shelf'. - Investment of 100K + maintenance of 5Kp.a. reduces flood damage at 0.2 m. depth by 380K Euros. - No public body admits responsibility to protect private properties. - Feeling that FRe should be part of FRM decision making process. - Insurers should reduce premiums where FRe installed.	- FRe should become part of systemic catchment scale FRM which promotes awareness and reduces domino effects. - LA reluctant to support individual protection initiatives and decision to do so should lie with individuals. - Companies/large organisations have information but this should also be made available to individuals. - Call for a community role in FRM. - Insurers can take FRe into consideration in flood risk assessment when the recipient demonstrates credible technical, financial and organizational capacities. It is unlikely that an individual could possess these capacities. - FRe can be taken into consideration in flood risk assessment by insurers when the insured demonstrates credible technical, financial and organisational capacities. This cannot be the case for individuals.	- Improved forecasting system implemented post 2002 floods which enable use of FRe technologies (p66). - Local flood authority does not feel that it has responsibility to protect individual properties with FRe beyond assisting with dissemination. - Scepticism re insurance. - Manufacturers want a certification which is accepted worldwide.

	GREECE	NETHERLANDS	SPAIN	WASHINGTON
	- Belief that governments should be responsible for FRe in critical infrastructure but that individuals should protect their own property. Reluctance to prescribe FRe over conventional solutions.	- Control and maintenance of FRe systems should be addressed in FRe planning and operation. - FRe not prescribed. - Information needs to be made available to individuals. Manufacturers feel certification will help uptake.	- Institutional capacity building, application of innovative solutions and building guidelines are being adopted. Collaboration amongst government agencies and with private institutions is required. - FRe needs to become part of the FRM system. - Lack of knowledge at community level constrains uptake. - Government as insurer of last resort constrains uptake of FRe.	- Responsibility should lie with a combination of government and individuals. - Insurers in the US are encouraging uptake of FRe.

	UK	CYPRUS	FRANCE	GERMANY
Local awareness of FRe	- Concerns about risk of further flooding and some use of FRe - Faith in FRe, if provided by a reputable agency but generally limited knowledge in maintenance. - Uptake hindered by lack of awareness of options & maintenance.	- FRe unknown (2.2).	- People consider a flood event of less than 20cm water inside a house as not serious but 20-50cm is unacceptable. - Homeowners don't want complex or smart technologies but prefer simple manual or automatic FRe.	- Pre 2002 low awareness High risk of flooding thus high local awareness of FRe.
	GREECE	**NETHERLANDS**	**SPAIN**	**WASHINGTON**
	- No local FRe systems or technology exists and no initiative is being taken.	- FRe only sporadically used.	- No awareness of FRe products or involvement in FRM by the population. - Absence of urban flood protection plans. Lack of education will hinder uptake.	- Awareness of FRe which has been advocated by US Corps of Army Engineers

	UK	CYPRUS	FRANCE	GERMANY
Local acceptance of FRe	- Evaluation of a FRe system relates to the acceptable level of damage. Uptake of FRe requires an understanding of the risk and benefits. - Government and/or the utility should fund FRe.	- Liked potential of FRe but aesthetics and independent verification will be important. - Lack of clarity re who is responsible for FRe.	- Impossible to protect all houses against any flood water depth- thus need to decide which houses and to which height. Implementation of a local barrier is choice of inhabitant but individual's actions can compromise actions by the LA. - FRe measures should be linked to an 'alert' (smart) system and accept that it might have to include human intervention. - Amount of advance warning is seen as a problem. - FRe should be responsibility of the homeowner but with grants being provided.	- People use sandbags, door and window barriers and pumps because they know how to handle them.
	GREECE	**NETHERLANDS**	**SPAIN**	**WASHINGTON**

	- Concerns re maintenance and malfunction as well as community involvement in perimeter FRe. - EU legislation offers opportunities for FRe but current turmoil hinders action. - Workshop participants were willing to pay for protection of their own homes.	- Potential for FRe in rural areas not covered by defences. - Government and home owners to provide FRe at household level.	- Education is required.	- A constraint to uptake is that FRe is an indicator of flood risk which might reduce value of property. - Financial assistance from government is expected for home level FRe.

	UK	**CYPRUS**	**FRANCE**	**GERMANY**
Local action on FRe	- Trust in FRe is generally low. - Process requires flood warnings and action by homeowner or LA if at area level. Barriers include lack of knowledge, trust, practicality, aesthetics, simplicity, maintenance and cost. - Price, aesthetics and practicality important but lack of feeling of security and of trust. - Need for an independent and nationally recognised standard acceptable to the insurance industry. - Some evidence that the insurance industry is only concerned in protection to houses on a recognised flood plain.	- Need for independent FRe system verification acceptable to insurance industry which is prepared to consider reduced premiums for proven FRe systems.	- Homeowners not interested in devices which might let some water enter premises. People do not want complex systems. - Lack of political leadership in FRM.	- Trust in product and cost/benefit is required. - People need reliable information and assurances about the long-term performance of FRe. - Insurers should facilitate uptake of FRe as is the case in Switzerland.

	GREECE	NETHERLANDS	SPAIN	WASHINGTON
	- Robustness is important.	- Additional rainfall/flood data required to assist homeowner's decision making (3.2 p77) as well as cost/benefit information (3.2, p78).	- Municipality seeking to build local capacity and to improve warning systems (3.2 p89). - Barriers for doors need to be accompanied by waterproofing floors and walls (3.2, p.92)	- All flood proofing involves government agencies which are generally trusted. - National flood insurance is being offered by the Federal Government at rates that private insures can't match. Federal government provides guidance and incentives for flood proofing.

Appendix 2: Methodology for Producing Guidance

Outline

As part of this report, The University of Manchester team developed and tested two separate 'guidance' documents – one for strategic decision makers, and another for members of the community. These emerged as key recommendations to help address the multitude of barriers that are inhibiting the road to market. These are designed to provide guidance for end-users as to what role FRe can play to help mitigate flooding, and to build their trust in FRe products and systems. While the written guidance pertains only to England and is therefore difficult to replicate verbatim in other regulatory contexts, the methodology and processes identified in the guidance can, to some extent, be generalised across Europe.

As well as drawing on the workshops, we conducted an online survey of flood risk management and design professionals that covered what a best practice guidance document should include to help them and what format(s) it should be made available in. The questions asked are contained in Appendix 2.2. We sent the questionnaire to all of those on our contact list as well as utilising broader professional groups, such as the UK's Local Government Association and the Royal Town Planning Institute. 117 responses were received. Simultaneously, we enlisted the support of a charitable flood support group to undertake a questionnaire of households who had installed FRe. This questionnaire (see appendix 2.3) was modified from the professional questionnaire to include questions on their practical use, along with their satisfaction with the FRe process. This was completed online, by phone and in print by 50 people. Following this, we drew together the questionnaire answers combined with the reviews in 5.3 and on-going meetings with government agencies, insurers and FRe manufactures, to develop the 3 'A's' outlined in this document (Awareness, Acceptance, Action) into a six step process for good practice in FRe. This covered 'Knowing the risk' through to 'Property Surveying' and, finally, to maintenance. A literature review of all available material was then conducted to gauge how FRe could fit into England's flood risk management systems as well as to point potential users to the majority of available guidance. Having secured the buy-in from numerous stakeholders through the method of developing guidance, it will be promoted heavily and it is anticipated that it will gain support to help develop the sector.

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Appendix 3: Professional survey

Introduction

Smart Resilience Technology, Systems and Tools - SMARTeST

Technologies for improved safety of the built environment in relation to flood events

Website: http://www.floodresilience.eu/

Small-scale flood protection products have the potential to make a significant contribution to flood risk management. Such technologies limit the damage caused by flooding and speed the recovery of people and places in the wake of water inundation. They may be used in conjunction with other features on a system basis, or by using smart features that deploy automatically. The UK is considered by many to be at the fore of this innovative and emergent industry. However, despite the contribution that this technology may make to increase our resilience to flooding, their use is neither *widespread* nor *comprehensive*.

As part of the EU-FP7 funded *SMARTeST Project*, and in close collaboration with representatives of the flood protection industry and other stakeholders, the University of Manchester and the Building Research Establishment have identified a range of barriers inhibiting the broader use of flood resilient technologies. These range from technological restraints to a lack of trust in products on the part of insurers and communities at risk of flooding.

We are currently developing a 'Best Practice Guide' that will both help to build *confidence* in flood protection technology and will support *efficient and effective decision-making* at all stages of flood protection product's 'road to market'. We hope this will serve as a reference document for product manufacturers, as a source of decision-support for practitioners, and as a guidance document for those that will use and be responsible for maintaining flood protection technology.

This brief survey will help us to ensure that the Guidance addresses the main concerns and barriers that face the uptake of flood protection technologies from your professional and personal perspective. We would like to ask for your opinion about the scope, content and format of the guidance to ensure it is most appropriate for your needs. We also want you to share best and bad practice.

The questionnaire contains 16 questions and should take you no more than 10 to 15 minutes to complete. Please remember that there are no right or wrong answers! Please answer all of the questions if you can. If there is something that you cannot answer then just leave it blank.

Please complete the questionnaire by **15th October 2012**

If you require the survey in an alternative format or if you have any questions about it, please contact us at:

angela.connelly-2@manchester.ac.uk

or

nigel.lawson@manchester.ac.uk

Your sector

1. Which sector do you belong to?
   - Central Government

- Local Government & Environment Agency
- Insurance industry
- Flood protection technology manufacturer/ installer
- Built environment professional (e.g. architect, planner, building surveyor)
- Consultancy
- Property developer/ construction industry/ landlord
- Other (Please state below)
- ----------

Scope & content of a best practice document

2. A best practice guide should support decision making for the use of flood protection technology. What information should such a document include?

Please rate the following on a scale of 1 to 5, with 1 being least important and 5 being most important.

- Best practice on the innovation and marketing of FRe products
- Best practice on pre-installation surveying
- Best practice on installation
- Best practice on professional post-installation maintenance
- Best practice on household maintenance
- Best practice on ensuring the ability of measures to be deployed by householders
- Outlining roles and responsibilities for flood risk management
- Education on different types of flooding
- Training guidance on how flood protection technologies work
- Overview of current policy and practice
- Overview of insurance and flood protection
- Checklist of questions for householders/other decision makers to ask when considering flood protection
- Advertising and advice about products

3. What else should a best practice document consider? In particular, what is missing from the list above that we could help address? Please provide examples where appropriate.

Qualitative response

4. To achieve its aims the guidance needs to be well targeted. What should its main aims be?

Please rate the following on a scale of 1 to 5, with 1 being least important and 5 being most important.

- Increase awareness of flood protection technology and how it works
- Training for householders on how to use and deploy flood protection technology
- Provide clarity on roles and responsibilities
- Outline and uphold industry quality standards
- Increase the awareness of best practice

- Promote trust in the sector more generally

5. Should there be just ONE guidance document aimed at multiple audiences, or multiple documents targeted at differing sectors (e.g. homeowner, flood technology provider, Local Authority?). Please explain your answer.
Qualitative

Best practice guidance users
6. Please identify, on a scale of 1 (least important) to 5 (most important) who best practice guidance should be aimed at?

- Architects/ planners/ designers
- Construction industry (including builders and developers)
- Consultants
- Surveyors
- Insurance sector
- Central Government
- Local Authorities
- Property owners/ landlords
- Mortgage Lenders
- Emergency responders (for instance the Fire Brigade)
- Emergency and Resilience Planners
- Flood protection industry
- Communities at risk and the general public

Other _____

7. Are there any other flood protection guides that could be useful for us to refer to when drafting the document? (Please provide details or web-links)
Qualitative

Operation
8. How would you, or you organisation, use the guidance (e.g. basic information/awareness, marketing, procurement strategies, quality assurance)? How do you think it could have the most impact for you?
Qualitative

9. An entirely voluntary practice guide may not be as effective as one that is required. Do you think it should be a requirement to formally sign up to the principles in the document (for example, online)? If so, who should sign up and how could it work in practice? (e.g. requirement of membership of body, requirement to provide services to Local Authority or Environment Agency, public declaration and/ or commitment)
Qualitative

10. Which of the following types of organisations could accept responsibility for ensuring compliance with the guidance? Please rate on a scale of 1 to 5 where 1 is less able and 5 is more able.

- Central Government

- Local Government & The Environment Agency

- Insurance industry
- Built environment professional (architect, planner, building surveyor)
- Consultancy
- Property developer/ construction industry/ landlord
- Voluntary sector or community organisation
- Flood protection organisation (please state who)
- ----------
- A combination of two or more of the above
- Other (Please state below)
- ----------

11. It is unlikely that guidance will be formally regulated. How should it be adhered to? What should happen if guidelines/standards are ignored? Who could be responsible for enforcing this?
Qualitative

12. Have you in mind another organisation or approach that could be used as a template for the code of practice?
Qualitative

Disseminating best practice
Please note we will not identify specific incidents or examples of practice. Rather, we would like to*highlight anonymous case studies of good practice in the guidance* to help understanding of flood protection technology.

13. What examples of standards of best practice in individual property level flood protection can you give for the following issues? (Qualitative)
- Marketing of products
- Raising Awareness
- Pre-installation Surveying
- Installation
- Customer care
- Maintenance

14. Similarly, we would like to know of examples of poor practice or incidents of when individual property level flood protection fails to reach its full potential. These would not be individually identified but rather to help people understand how the technology should work best.
Qualitative

Finally...
15. Would you be willing to comment on a first draft of the guidance during Autumn 2012 and/or contribute more information on best practice?

Yes
no

Please leave your contact details if you answered yes (these details will never be shared with any other organisation or publicised in way)
Name:
Organisation:
Job Title:
E-mail:
Phone number:

16. If you have any further comments or additional information on any aspect of this issue please put them in the box below.
Qualitative

Appendix 4: Community Survey

PROPERTY LEVEL FLOOD PROTECTION: PRODUCTS, MANUFACTURING AND BEST PRACTICE GUIDANCE

QUESTIONNAIRE

Introduction
Property level protection for flooding has the potential to help householders and communities in areas where large-scale defences are inappropriate or where there is the threat from unpredictable surface water flooding following heavy and intense rainfall. The technology is continually evolving. It may help to limit the damage caused by flooding and speed the recovery of people and places following a flood *However, despite this potential, the use of property level flood protection is not widespread.*

About Us
As part of a European-wide project, The University of Manchester and the Building Research Establishment (BRE) have worked closely with stakeholders throughout the industry as well as the National Flood Forum, Defra, the Environment Agency and the insurance industry to identify a number of barriers to the use of property level protection. These range from a basic lack of information to a lack of trust in the performance of the products throughout the insurance industry and amongst householders.

You can learn more about our work here: www.floodresilience.eu

This questionnaire is being administered by the National Flood Forum on our behalf and the results will be used to develop a 'Best Practice Guide'. The University researchers may use the anonymous data to write a scientific paper for the academic community.

Best Practice Guidance
We want to develop a 'Best Practice Guide' that is hoped to address some of these barriers by promoting trust. We want the guidance to serve as a reference document for product manufacturers on best practice, and as a support tool for decision makers and households that are looking to install measures to increase the level of resilience against flood risk in their homes. We expect that the guidance could address issues such as:

- Increased awareness of property level protection and how it works
- Providing clarity on roles and responsibilities
- Outlining and upholding industry quality standards
- Increasing the awareness of best practice
- Promote trust in products and manufacturers

Your Opinion
We can't make best practice guidance on our own. To ensure that it becomes well-used, we need to know how best to involve people who have experience of property level protection in their household, and we have designed a survey to do that.

The survey will ask you about your experience of property level flood protection from advertising through to maintenance. We will also ask your opinion about the content and format any guidance should take so that

it may achieve what it sets out to do. There are 33 questions in total and you can complete it by telephone, posting or emailing a copy, or else online. We estimate that it will take around 30 minutes to complete. It is entirely anonymous. Please remember that there are no right or wrong answers and if there is something that you don't feel able to answer then please leave it blank/ or say that you cannot answer it.

Please note that your details and the answers that you give will remain confidential. The only people to see them will be the National Flood Forum and the researchers at The University of Manchester. The survey is entirely voluntary. You can withdraw at any time. If you wish not to take part at a future date, please contact us on the details provided below and we will ensure that your answers are erased.

Thank you for your help

Filling out the questionnaire
Some questions ask you just to select the answer appropriate for you. Please place an X in the relevant box.
Other questions ask you to rate a particular statement. Please write a number between 1 and 5 next to '**Score:'**

Certain questions ask you to write a sentence or two about your opinion. If you have any questions then you can contact us on the details given below

Contact Us
Dr Angela Connelly (Research Associate), School of Environment and Development, The University of Manchester:
angela.connelly-2@manchester.ac.uk
0161 275-0809

Amanda Davies, National Flood Forum**,** Old Snuff Mill Warehouse, Park Lane, Bewdley, Worcestershire DY12 2EL
amanda.davies@floodforum.org.uk
Tel 01299 403101

PRELIMINARY INFORMATION: ABOUT YOU

I. Where do you live? - Local Authority or area of residence

II. **What sort of place do you live in?**

Terrace house	
Detached house	
Semi-detached	
Flat	
Apartment	
Other	

III. Approximate age of the property

pre 1918,	
1918 - 1945	
1945 – 1980,	
1980 – 2000,	
After 2000,	
don't know	

-

IV. How long have you lived there? _____ years _____months

V. Ownership:

Owner occupier	
Private rent	
Social housing	
Landlord,	
Other	

VI. What is the approximate value of the property? If you rent please put your average monthly rent.

£_____

VII. What is your level of education?

University level	
Professional Qualification	
A-level (or equivalent)	
GCSE (or equivalent)	
No Qualifications	

VIII. How many times have you been flooded in this property?

_____ **times**

IX. Are you considered to be at risk of flooding (as either identified by your local authority or the Environment Agency flood maps)?

Yes	
No	
Don't know	

SECTION 1: EXPERIENCE OF PROPERTY LEVEL PROTECTION: MARKETING, INSTALLATION, MAINTENANCE

1. What types of Property Level Protection have you installed in your home (please mark all that apply?

Fixed flood doors	
Automatic air brick covers	
Earth bund	
Non-return valves	
Automatic pump	
Window barriers	

External wall treatments	
Community level measure (e.g. large floodgate or barrier)	
Other (please state)	

*Please state 'other' here*_____

2. How did you find a supplier?

I used the Blue Pages directory on the National Flood Forum website	
I looked in yellow pages/ telephone directory	
Word-of-mouth from a friend or neighbour	
An internet search engine (e.g. Google; Bing)	
I looked at the Environment Agency information and advice	
I received information from my insurer	
I was approached by a manufacturer	
I was approached by the local authority	
I was approached by my water company	
Other (please state below)	

Please state other here _____

3. Did you receive grant aid for property level flood protection products?

Yes - From the local authority.	
Yes - From the Environment Agency/ Defra	
Yes. I received assistance from elsewhere (please state here): _____	
Yes. I don't know who from	
No	

4. **Was a pre-installation survey undertaken**

Yes (please go to question 4)	
No (Please go to question 6)	
Not sure (Please go to question 7)	

5. **On a scale of 1 to 5 please indicate the extent to which you feel that the recommendations made by the pre-installation survey adequately assessed your need and circumstances.** (1 is extremely dissatisfied and 5 is highly satisfied)

Score: _____

6. **On a scale of 1 to 5 please indicate the extent to which you feel that the pre-installation survey recommended products that you are confident about using during a flood.** (1 is no confidence at all and 5 is very confident)

   Score: _____

7. **Who installed the property level flood protection?**

Self-installation	
Manufacturer	
A third-party (please state type e.g. builder, recognised PLP installer) _____	
Don't know	
Other (please state) _____	

8. **Once Property Level Protection was installed, was a subsequent survey undertaken to check the installation?**

Yes (please go to question 9)	
No (Please go to question 10)	
Not sure (Please go to question 10)	

9. **If you answered yes to the previous question could you indicate (on a scale of 1 – 5) how happy you were with the post-installation survey? (**1 is extremely unhappy and 5 is very happy)

   Score: _____

10. Were you given advice on how to maintain and care for the Property Level Protection installed in your household?

Yes (please go to question 11)	
No (Please go to question 12)	
Not sure (Please go to question 12)	

11. In what format(s) did you receive the maintenance advice in?

Verbally	
Given an internet address	
Given printed instructions	
Given a telephone number for help	
Other (please state below)	

Please state other here: _____

12. How often have you – or another person – maintained, inspected or tested your product(s) since installation?

I do not regularly check it except when there has been a flood warning or potential for heavy rain	
Regularly – biannual or more often	
Annually	
Every 2 to 5 year	
Other (please state here):_____	

13. Please think of the whole process. Please indicate on a scale of 1 to 5 the following list of items which are intended to measure the quality of the help that you received. (1 being least happy and 5 being most happy)

a. Extent to which you felt that any guidance and help you were given was expressed in a language that you understood?

Score_____

b. Extent to which it took account of your personal circumstances and ability

Score_____

c. Extent to which it was affordable for you

Score_____

d. Extent to which there was help available to assist payment

Score_____

e. Extent to which you have increased in confidence that your property is protected

Score_____

f. Extent to which you have increased your confidence in using Property Level Protection equipment

Score_____

14. Have you been flooded since installing PLP? To what extent has the product worked?

_____
_____
_____
_____
_____

15. If the product didn't work, what, if anything did you do about it? Can you explain what measures or actions (if any) that you took in the event of product failure?

_____
_____
_____
_____
_____

SECTION 2: PROVIDING GUIDANCE: SCOPE & CONTENT

16. We think that any guidance should help people to make decisions on products when choosing to make their home more resilient to flooding. What information would it be useful to include to help you make decisions?

Please rate the following on a scale of 1 to 5, with 1 being least important and 5 being most important.

How Property level Protection products are advertised	**Score:**
Standard product specifications and labelling	**Score:**
Best practice on surveying homes before and after installing products	**Score:**
Best practice on the installation of products	**Score:**
Best practice on maintaining products after fitting	**Score:**
Outlining who is responsible for flood risk management	**Score:**
Education on different types of flooding and how flood protection technologies work	**Score:**
Checklist of questions to ask	**Score:**
Overview of flood protection and insurance	**Score:**

17. What else should a best practice document consider? Is there anything missing from the list given to question 16 that we could help address?

_____

_____

_____

. *main aims* be*?*

Please rate the following on a scale of 1 to 5, with 1 being the least important and 5 being the most important.

Increase awareness of flood protection technology and how it works	**Score:**
Educate people on how technology may be deployed and maintained	**Score:**
Provide clarity on roles and responsibilities	**Score:**
Outline and uphold industry quality standards	**Score:**
Increase the awareness of best practice	**Score:**
Promote trust in property level flood protection products and manufacturers more generally	**Score:**

19. How would you like the guide to be produced? For example, should it be a document for print, or download, a web portal, a combination of these or something else?

20. In terms of flooding, are there any existing guides that you have found particularly useful?

SECTION 3: PROVIDING GUIDANCE: OPERATION

21. On a scale of 1 to 5, would you be more likely to purchase a product if the manufacturer had signed up to a formal code of practice/ guidance principles? 1 being less likely, 3, neither more or less, and 5 being much more likely.

Score: _____

22. It is unlikely that the guidance will be regulated by local or central government. What should happen if the guidance/ standards are ignored? How could they be enforced?

23. Which of the following professions would you TRUST to accept responsibility and be able to ensure compliance with the guidance? Please rate on a scale of 1 to 5 where 1 is least confident about their ability and 5 is most confident about their ability

Central Government (including executive agencies)	**Score:**
Local Government	**Score:**
The Insurance Industry	**Score:**
Built Environment Professional (architect, planner, surveyor)	**Score:**
Consultancy	**Score:**
Property Developer/ Construction Industry/ Landlord	**Score:**
Voluntary Sector or Community organisation	**Score:**
Flood protection organisation (Please give details below)	**Score:**
A new organisation (Please give details below)	**Score:**
Other/A combination of one or more of the above (Please give details below)	**Score:**

24. Please use the text box to capture anything that has not been covered and that you want to share about your experience of Property Level Protection products and their manufacturers. Please think about what you consider to be best practice or bad practice (We will not use this to identify any specific incidents or manufacturers – we want this information to help people understand how the technology works in practice)

Appendix 5: Example Guidance Documents Pertaining to England

The following two documents (beginning on p. 61) have been produced using the gathered information that resulted from the tasks outlined in Appendix 2. The first is aimed at property owners. The second document is aimed at those who may be involved in local flood risk management – from local authorities, to politicians, to the insurance industry – so taking account of the fragmented nature of flood risk management in England.

This document was produced as part of the SMARTeST project
(Smart Resilience Technologies, Systems and Tools)
an FP7 funded project (Project no: 244102)

http://floodresilience.eu