Collaborative Flood Risk Governance at Property Scale: the Challenges and Discourse around Property Level Flood Risk Data in England

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Submitted in partial fulfilment of the requirements of Oxford Brookes University for the award of Doctor of Philosophy

August 2019

To the memory of Professor Ray Ogden

Abstract

Flooding in the UK is reported to become a more severe and localised phenomenon in the future due to climate change (EA, 2009b; Evans et al., 2004) and the population growth (DEFRA and EA, 2006a). To date, it has been estimated that one in six properties in England and Wales is at risk of flooding (EA, 2009b). Study on components of flood risk suggests that damage sustained by buildings during flood events can vary considerably depending on the characteristics of the flood hazard and individual building characteristics. Although this risk can be highly variable, no systems exist with which risk and cost of rectification can be considered in context. In this study, Property Level Flood Risk Data (PLFRD) is referred to as the combination of data describing the flood hazard and vulnerability of domestic properties. Despite the theoretical benefits of use and availability of PLFRD to a variety of stakeholder groups involved in flood risk governance in England, at the moment at the scale of individual properties, whilst flood risk management stakeholders can determine the risk of individual properties as a consequence of their physical location within flood risk maps, they cannot establish property level factors that might reduce or increase risk. Therefore, the lack of clarity and knowledge in the PLFD discourse constitutes a gap in the existing literature. This study suggests a theoretical fame work that combines governance theories and theories of scale to structure the approach to address this gap under four core concepts: discourse, distribution of power, rules of the game and actors and coalitions. The identification of the factors influencing this gap is the contribution to the knowledge of this study.

A qualitative approach was developed for further investigation of the issue. This involved understanding the characteristics of the key stakeholder groups (i.e. government, insurers and the property owner) and investigating the existing opportunities and limitations in uptaking of PLFRD. The main sources of evidence were semi-structured in-depth interviews with experts, each representing the key stakeholder groups, and expert's observations. This included interviewing representatives from Department for Environment, Food and Rural Affairs, Environment Agency, Ministry of Housing, Communities and Local Government, local governments, Individual insurers, loss adjustors, Flood Re, and community representatives. 12 pre-set themes were selected from three government documents published in 2010 and 2011 to guide the data collection and data analysis process. New themes and relations were explored where appropriate.

This study offers a unique insight into factors influencing the adoption of PLFRD into professional practice, integrating government, insurers and property owners' position and perspectives. The findings of this study suggest that during 2010 and 2011, the case for PLFRD was not strong enough to overcome the barriers mainly due to lack of evidence and understanding of the characteristics that distinguished each stakeholder group's approach towards PLFRD. Key influencing factors and the significant distinguishing characteristics were established. Results also contributed valuable insight into the future and ongoing incentives for PLFRD related projects such as Flood Re and similar flood risk management multi-stakeholder initiatives. The findings of the study highlighted the different value of PLFRD for different stakeholders as key to its effective uptake. It also identified the factors that influence the value of PLFRD. Understanding these differences and the underlying factors can benefit the implementation of evidence-based practice in risk management and future development of a multi-stakeholder risk database.

Acknowledgements

Completing this multidisciplinary PhD would not have been possible without the accompaniment of many generous individuals and institutions. Firstly, my appreciation goes to the memory of the leader of my study and my mentor, Professor Ray Ogden whose fatherly support, wise advice and inspiration enabled me to be where I am today. I would also like to extend my appreciation to Dr Martin Heywood, Dr Nicholas Walliman and Dr Bousmaha Baiche for their help.

My thanks go to the experts I interviewed for my research who I have had the privilege to get to know during my field research, I am grateful for their time and their openness which provided me with valuable data and insight. I am also very grateful to Oxford Brookes University for funding my study, and Ms Jill Organ for her kindness and support throughout the administrative changes that followed the heartrending loss of my lead supervisor.

I would like to thank Sadjad Tajdaran, Dr Dimitrios Moutaftsis, Martin Dolan and Achara Khamaksorn for their friendship and support.

Finally and above all, to my beloved husband Shahab who has been my dearest friend and my biggest motivation for finishing this PhD. Thank you for all the fresh critical comments, for being there for me both intellectually and spiritually and keeping me sane in my most difficult moments.

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LIST OF ACRONYMS AND ABBREVIATIONS

ABI	Association of British Insurers
BIBA	British Insurance Brokers' Association
BSI	British Standards Institute
BRE	Building Research Establishment
DEFRA	Department for Environment, Food & Rural Affairs
DCLG	Department for Communities and Local Government
EA	Environment Agency
FRM	Flood Risk Management
FOI	Freedom of Information Act
MHCLG	Ministry of Housing, Communities and Local Government
NFF	National Flood Forum
OGL	Open Government Licence
PFR	Property level flood resilience and resistance
PFR-d	Property Flood Resilience database
PLFRA	Property Level Flood Risk Assessment
PLFRD	Property Level Flood Risk Data
PLFRM	Property Level Flood Risk Management
RICS	Royal Institution of Chartered Surveyors
SoP	Statement of Principles

Chapter 1: Introduction

1.1 Background

Flooding is a global challenge causing great losses to human settlements and life. In the UK, flooding is amongst the most persistent of natural disasters causing the greatest monetary loss (Brown and Damery, 2002) and has been identified in the National Risk Register and UK Climate Change Risk Assessment 2012 as a significant current and future risk in England (HM and Government, 2012). In last few decades there has been a significant surge in the severity and frequency of flood events (e.g. Milly et al., 2002; DEFRA, 2009a; Adaptation Sub-Committee, 2012; EEA, 2012; DEFRA, 2016a), which is often associated with climate change (EA, 2009b; Evans et al., 2004) and population growth (DEFRA and EA, 2006a). This resulted in more homes experiencing flood damage in recent years.

Residential dwellings have significant importance to the economy and commonly damage to them comprises a significant share of the total flood damage in UK big flood events (EA, 2018a). It has been estimated that one in six properties in England and Wales is presently at risk of flooding (EA, 2009b), and if global temperatures continue to rise as predicted, even more, homes will be exposed to higher risk (Adaptation Sub-Committee, 2012). Understanding the risk to individual properties and making properties more flood resilient can hugely benefit individuals, families and businesses (ODPM, 2003; DEFRA, 2010; DEFRA, 2016b). The evidence of recent floods and the projection of increasing frequency and intensity of the future events highlight the need for optimising flood risk management approach to mitigate its adverse impacts.

Traditional methods of flood management policy in the UK favoured technological solutions to hazard reduction and focused mainly on constructing hard-engineered defences. Yet, since the 1990s, the shortcomings of these methods in providing a comprehensive solution together with concerns regarding their long-term sustainability in the face of climate change and increasing new developments in floodplains (Brown and Damery, 2002) resulted in the emergence of the Flood Risk Management (FRM) approach. FRM adopted a holistic approach which includes the interaction between three core components including (i) evidence-based multi-tier decision making based on data and information, (ii) modelling and risk analysis and a greater emphasis on vulnerability, (iii) and multi-stakeholder (DEFRA, 2000; Hall et al., 2003; EEA, 2011; EU flood Directive mentioned in Thieken et al., 2014 Parliament, 2010; Scottish Environment Protection Agency, 2012). This approach relies on providing data to the stakeholders to ensure that the best decisions are made to minimise flood risk. Following the EU Flood Directive 2007, there have been several attempts by different organisations to improve the available data relative to frequency and potential of flood events in the UK e.g. Pitt Review (2008) and Flood and Water Management Act 2010.

To determine the effect of flood hazard on residential buildings, the hazard parameters must be translated into a form which indicates an effect on the building i.e. the building vulnerability (Scottish Environment Protection Agency, 2012; Merz, Kreibich and Lall, 2013; Klijn et al., 2015). In this study, the combination of flood information and the physical characteristics of the domestic property are referred to as Property Level

Flood Risk Data (PLFRD). Types of data that is commonly suggested for this purpose are discussed in section 2.2.2.

At the property level, flood risk data offers a unique tool to support evidence-based decisions (Cannon et al., 1995; Ten Veldhuis and Clemens, 2010) for a variety of decision maker groups including the government, the insurance industry, and homeowners. It facilitates the adoption of effective flood risk mitigate measures to reduce the possible damage from flood, minimising the recovery time and investment following an event (Lamond, Proverbs and Hammond, 2009; Joseph et al., 2011), assists insurers with decisions regarding premium setting of individual clients (Merz et al., 2010b) and informs emergency planning (Messner et al., 2007; DEFRA, 2010). In that light, there have been several attempts to improve the use and availability of Property Level Flood Risk Data (PLFRD). These attempts include the reports *Availability and Uses of Property Level Flood Risk Data and Information* (DEFRA, 2010) *Flood risk and insurance: A roadmap to 2013 and beyond* (DEFRA, 2011) and *Flood and Coastal Risk management Risk Mapping Strategy* (EA, 2010). These three government documents suggested a number of recommendations for the key stakeholder groups concerning three key areas for improving PLFRD. These areas comprise data consistency and standardisation, data sharing and communication, and data supporting the effectiveness of property resistance and resilience measures.

However, a review of the current use and availability of PLFRD amongst the three key stakeholder groups i.e. government, insurers and the property owners suggests that despite the apparent benefits of property level flood risk information and the recommendations suggested in the government documents noted above, the use of such data within the relevant stakeholder groups is not established. Whilst flood risk assessment stakeholders can determine whether individual properties are at risk as a consequence of their physical location within flood risk maps, they cannot establish property level factors that might reduce or increase risk. The reasons for this discrepancy represent a significant gap in knowledge. Therefore, a need is highlighted for further research to understand the influencing factors and their effects on the current and future state of PLFRD.

1.2 Research problem

According to the information provided by the background review, the current state of PLFRD amongst the key stakeholder groups does not offer evidence of the practical use of property level flood risk data as an improvement upon the generalised areal information. Accordingly, the problem in this research can be briefly formulated as follows:

> Despite the emphasis placed on the benefits of improving the use and availability of property level flood risk information as a mean to enhance the collaborative multi-stakeholder flood risk governance at the scale of individual property, there has been no evidence of facilitating access to such data as a common practice amongst the key stakeholder groups.

This problem is a barrier for effective multi-stakeholders flood risk management decision making at the local level and an impediment for the optimised adoption of evidence-based mitigation solutions for improving residential building flood resilience. The literature review suggested several guidelines and recommendations

that called for the improvement of quality and availability of such data. Most notably are the correspondent government recommendations in DEFRA 2010, DEFRA 2011 and EA 2010. They highlighted the potential benefit of such data for a variety of stakeholder groups and improving the risk management at the level of the individual building. Despite the theoretical discussions on potential benefits of such data and the corresponding recommendations in several government documents, no research or practical evidence exists in the literature that provides an explanation for the absence of common use of such data in the key stakeholder groups. Finding reasons for this will involve understanding the characteristics of the key stakeholder groups' needs and investigating the existing opportunities and limitations in taking up property level data in flood risk management.

1.3 Aim and objectives

1.3.1 Research aim

The overall aim of this research is to identify and assess key indicators and critical elements of flood risk governance that create successful risk management at the scale of property level in England from a social and political perspective. It also seeks to characterise more generic implications of multi-sector risk governance at the scale of domestic properties through the lens of use and availability of risk data.

1.3.2 Research objectives

In order to define the scope of this research and to achieve its aim a number of objectives were defined which are outlined below.

Objective 1: To understand and clarify

a) Components of flood risk management and their definitions at the property level with the focus on the role of data
b) key actors and the evolution of their role in managing risk to individual properties

Objective 2: To develop a conceptual model of the relationship between flood risk governance and scalar arrangement.

Objective 3: To identify critical elements that characterise flood risk governance in England at the scale of property level based on in-depth expert interview approach. This will comprises appraising the key influential factors in facilitating property level flood risk data with respect to the needs and requirements of key stakeholders and ascertain opportunities and barriers where applicable.

Objective 4: To contribute to the evidence based flood risk governance, particularly in the context of multi-sector risk governance at the property level scale and the role of power, rules, actors and discourse.

The research approach for achieving the objectives and meeting the aim of this research is provided in the following section.

1.4 Research approach

This study focuses on data relevant to the direct tangible flood damage to domestic properties in the UK. Other types of data such as those describing indirect or intangible damage are regarded beyond the scope of this thesis. As the first step to establishing the conceptual design framework of the study, a thorough review of the relevant literature in the area of flood risk management and the role of data and information was

conducted. This included a wide range of books, articles, government report, legislation and guidelines in addition to other relevant sources including consultation with experts and observations. This assisted in the identification of the gap in knowledge and the structuring of the research problem by gaining new perspectives and insights into different aspects of PLFRD that were being debated by the stakeholder groups. This has led to the development of a suitable approach to investigate the issues and influencing factors that are relevant to the gap in knowledge.

Subsequent to the failure of literature to explain the discrepancy between official recommendations and resulting actions, this research used in-depth expert interview methods to collect data and analyse the influencing factors that led to the current situation. Eventually, 12 aspects of PLFRD and three stakeholder groups were selected to carry on the investigations. The results of the interviews were analysed using a thematic analysis. Each interview was analysed using 12 pre-formulated themes that each reflect one of the 12 important aspects of PLFRD formulated from the literature review. New themes and relations were explored where appropriate. Within the timeframe of this study, a number of limitations to the scope of this study are anticipated. Due to the complexity of the subject and extensive nature of stakeholder groups involved, this study did not undertake a detailed analysis of all the possible aspects from the view of every stakeholder at any level of engagement. Instead, the analysis concentrated on the 12 different aspects according to the perspectives of three key stakeholder groups. Details of the process of making these selections, supported by the literature review findings in Chapter 2 and Chapter 3, will be further discussed in section 3 of the methodology chapter of the study.

1.5 Thesis structure

This dissertation is structured in four stages comprising an introduction, background, research, and synthesis, each of which may contain one or more chapters. The order and overall contents of each chapter are briefly explained in

Figure 1-1.

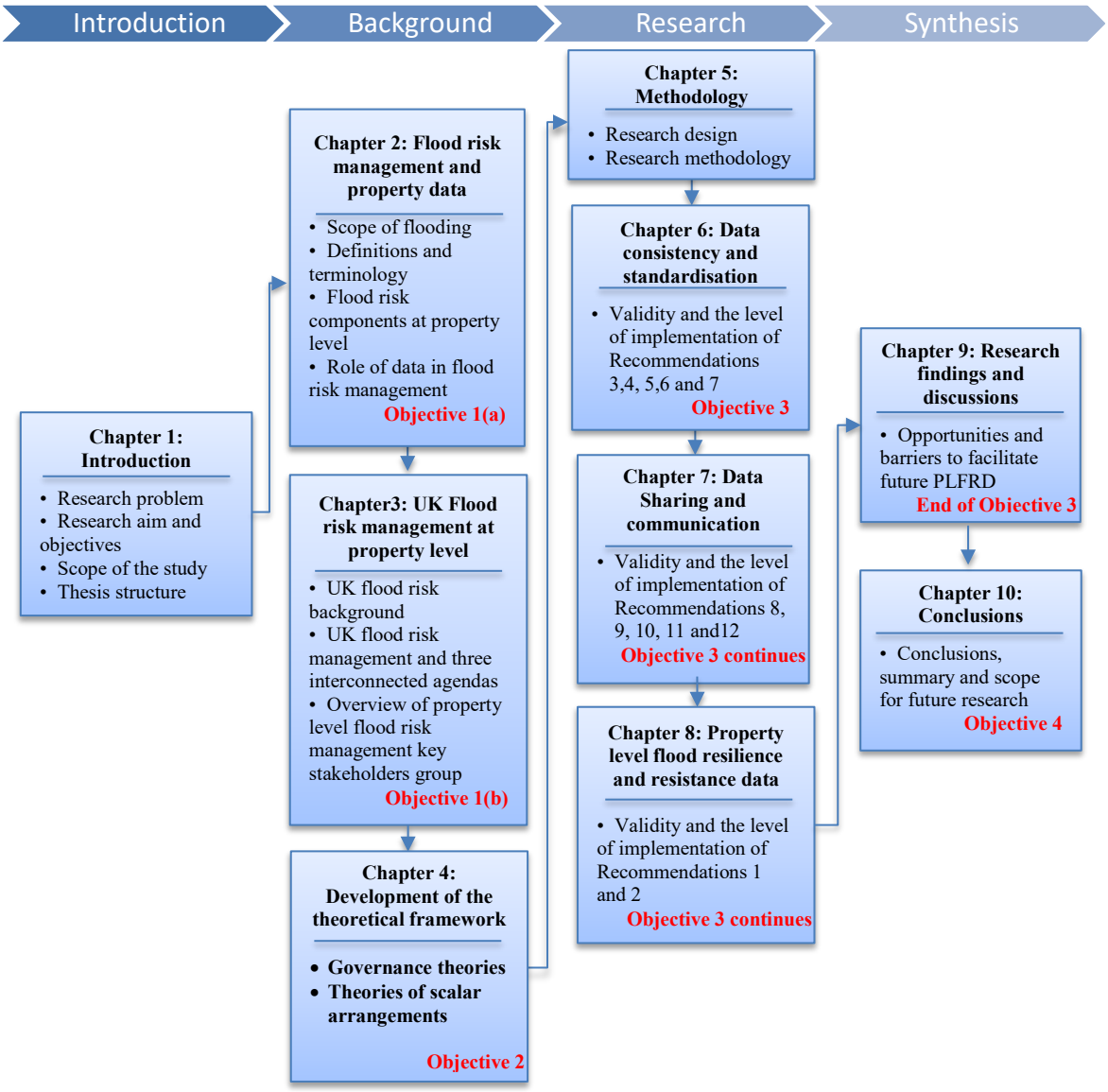

Figure 1-1 Chapter structure of the thesis

Chapter 2, together with Chapter 3, form the theoretical backgrounds of the study. Following a review on the concept of flood and flood risk management system in the UK, this chapter outlines information available in the literature about the characteristics and role of key stakeholder groups that have a direct impact and dominant role in managing flood risk at the property level.

Chapter 3 critically reviews the current key flood risk management stakeholder groups at the level of domestic property, including the nature of data they commonly use and have available, to the extent that was attainable from the literature. It presents a review of the UK flood risk management (FRM) structure and the responsibilities that different stakeholders have at the property level.

Chapter 4 identifies the key concepts that are used in this study with the aim of understanding the processes involved in the formulation of FRM at the scale of individual level and the key factors that influence them. In order to link and orient FRM in the theoretical literature, the conceptualisation process is undertaken to connect two broad areas of knowledge: risk governance and scalar arrangement of risk management. It identifies the socio-political challenges that face the process in England and the mechanism that has been

adopted to address them, through key actors over time. The goal is to develop a theoretical framework for analysing FRG at the scale of property level in England.

Chapter 5 outlines the selected research design and methodological approach to meet the research objectives. Together with the overall approach of the research to the social world, detailed methods of data collection and data analysis, and the key choices that informed the researcher's approach are explained.

Chapters 6 to 8 present findings related to factors that influence the widespread use of property level approaches in relation to risk management amongst the key stakeholder groups. This is followed by an analysis of the results of the interviews in respect of each recommendation and explanation of the level of implementation. It also discusses the counter-arguments and motives. To avoid repetition and to provide consistency in meeting the research objectives, the recommendations are divided into three thematic groups based on their area of concern and the commonality factor expressed for the level of implementations by the interviewees.

Chapter 9 consolidates the findings defined in chapters 6 to 8 into themes based on elements of conceptual framework and conclude the theoretical implications of each group to build insights on the flood risk governance in the specific context of England at the scale of property level. It reviews and adjusts the conceptual framework developed in Chapter 4 to better reflect the nuances drawn from the data analysis and findings.

Chapter 10 summarises how the research has addressed the aims and objective of this study. It then highlights the key findings and how they contribute to the new knowledge on both theoretical and practical level. Following that, the limitations of the study and highlights some of the challenges faced during the process. It then concludes with limitation of the research and recommendations for future research and provides a final concluding note on the overall process.

Chapter 2: Flood Risk Management and Property Level Data

2.1 Introduction

In the previous chapter, an introduction to the thesis was presented and the general research strategy, research area and its aim and objectives were presented. In response to objective 1(a), this chapter reviews the extent of impacts of flooding on households and properties by defining the concept of flood risk and its components. The categories that this impact can be examined by are presented. The crucial role of Flood Risk Management (FRM) and associated data, models of analysis and stakeholders are highlighted. The scope of the discussion is restricted to the UK FRM framework. Following the UK regulatory framework, FRM roles and responsibilities are reviewed with further focus on those concerning properties at risk. Subsequently, a critical summary of the scale of FRM in the UK and the risk at the property is presented and the potential key stakeholder groups are explored. The chapter concludes by revealing the knowledge gap in the context of the scale of property level risk management.

2.2 The issue of flood risk at the property level

The EU Flood Directive 2007 and UK Flood Risk Regulation 2009 define flood as any case where land not normally covered by water becomes temporarily submerged (DEFRA, 2009c). Flood is a worldwide issue, posing a threat to human settlements. It can have a diverse effect on the environment, infrastructure, human health, social and economic welfare of the individual and the communities (Thieken et al., 2005; Parliament, 2010). Since 1980, floods have been responsible for around 40,000 fatalities or injuries globally and have affected nearly 95 million individuals each year (CRED, 2014 cited in Amirebrahimi, 2016). It is one of the most common and costliest natural hazard around the globe (Bhanumurthy and Behera, 2008; Jha, Bloch and Lamond, 2012). It accounts for 20- 30% of the global economic losses from natural hazards (Douben and Ratnayake, 2006).

In the UK, flooding is the most repeated and common natural disaster causing significant socio-economic trauma (EA, 2015a). The 4th Annual Natural Hazards Risk Atlas rates the UK as the seventh in the global ranking of economic exposure to flooding due to high population density and infrastructure in flood-prone areas. Some of the examples of recent UK flood events include the 2000 flood which was reported the wettest since 1766, causing damage to over 10,000 properties. The 2007 floods left the country with over £3 billion of damage and recorded the largest peacetime emergency since World War II (Pitt, 2008). In 2015 storms Desmond, Eva and Frank during December instigated a number of flood events causing over 3,000 families seeking alternative accommodation while repairs are made to their homes and the insurance industry's total payout was estimated to reach £1.3 billion (ABI, 2016).

This risk is expected to become more extreme and frequent due to climate change and new development in floodplains (Stevens, Clarke and Nicholls, 2016). The impact of climate change in more extreme weather conditions and a shift in rainfall patterns are well documented (e.g. Milly et al., 2002; DEFRA, 2009a; Adaptation Sub-Committee, 2012; EEA, 2012). The UK Climate Change Projections 2009 reported that over the last 250 years the amount of heavy downpours in autumn and winter has increased notably (DEFRA,

2009a). This increases the chance of flooding in any given year by up to four times by the 2080s and increased the likelihood of extreme flood scenarios by up to eleven times (DEFRA, 2012a). Population growth also aggravates the risk of flooding by increasing the number of people exposed to the hazard (DEFRA and EA, 2006a). It also increases the burden on drainage systems and promotes urban expansion into areas at high risk of flooding or change on the land use and decreases the ability of the land to absorb the flood water (populationmatters.org, 2016). According to population growth scenarios, the number of people at significant risk of flooding is expected to escalate by about 13% in the 2020s, 30% up until 2050s and 45% in the 2080s (Sayers et al., 2015).

2.2.1 Spatial scale of risk and response

Flood risk management can engage at different scales e.g. national, regional and local. Accordingly, risk is generally assessed in three spatial scales; high, intermediate and detailed levels (DEFRA and EA, 2014c) or similarly macro, meso and micro levels (Reese, 2003; Messner et al., 2007; Merz et al., 2010b; Sayers et al., 2013; de Moel et al., 2015).

- Macroscale studies adopt high-level decision making at (inter-)national and sometimes regional levels; consideration is given to political goals and fundamental decisions
- Mesoscale studies are at a regional level extending down to local government, and receptors are clustered together for analysis. The main focus is to support regional planning and proprieties with the protection plans at this level.
- Micro studies range from local government area down to individual objects like buildings which serve the needs of detailed analysis for risk assessment. Whilst Macro and mesoscale risk assessment are typically based on aggregate data, micro level evaluates damage at a smaller unit and is usually object-oriented.

These scales not only define the spatial boundaries of interest but also implicit the expected precision of data, the level of aggregation of inputs and outputs data, the fitness for purpose of the data, and the cost of such investigation which define the engaged stakeholders, their decisions, and selection of analysis methods (Reese, 2003; Hall et al., 2003; Sayers et al., 2013; DEFRA and EA, 2014b).

This study narrows down the scale of research to micro level flooding with the focus on the physical effect of the flood on individual residential buildings i.e. property level. It is estimated that floodplains make up to 20% of England's land and accommodate 8% of all properties (EA, 2009a). The economic cost of flood events categorises residential properties as the most affected. For instance, based on physical damage to residential properties and contents, the EA estimated the damage as up to 38% in 2007, 25% in 2013 -2014, and 22% in 2015-2016 (EA, 2018a).

The national land use statistics in England warned that the number of new residential addresses built in high flood risk areas is increasing, either because more land is identified as being exposed to flood risk (DCLG, 2016) or the increasing rate of new developments in floodplains (Adaptation Sub-Committee, 2012). Overall, by the 2080s it is estimated that the number of properties at high risk of flooding (river or tidal) will increase to about 1.3 million if the defences are maintained to present crest levels and condition. That is a 35%

increase in number, and 75% increase in Expected Annual Damage to properties for the period of the 2020s (DEFRA, 2012a). This will put even a larger number of people and houses potentially at risk of flooding and highlights the strong need for the activities of flood management to reduce risks and prevent a disaster and also preparation for a suitable response.

The uncertain future outlook and the growing risks of floods to communities require their preparedness and resilience. This need has been restated in a number of national and international strategic documents such as Hyogo Framework for Action (ISDR, 2005), Sendai Framework for Disaster Risk Reduction 2015-2030 (UNISDR, 2015), the European strategy on Adaption to Climate Change 2013, and Making Space for Water (DEFRA, 2004). Similarly, DEFRA Flood and Water Management Bill states that '*It will be important to understand the potential consequences and help communities to become more resilient and adapt to changing levels of risk'* (DEFRA, 2009b: paras 60, 65). Resilience activities generally, encompass three overlapping stages, i.e. prevention, response and recovery, all of which require long-term investments in different aspects of the community and the delivery of a wide range of activities prior to, during and following a disaster (Berkes, 2007; Zevenbergen et al., 2008). It requires partnerships between the key players at national, regional and local levels (Penning-Rowsell, Johnson and Tunstall, 2006; Lamond, Proverbs and Hammond, 2009) improving citizen risk awareness, and developing the resilience of properties via changes in current Flood Risk Management (FRM) policy (DEFRA, 2008).

2.2.2 Flood risk definition

Natural hazard studies conceptualise 'risk' through understanding its components. For instance, it can be defined as a factor of the hazard and the level of vulnerability of elements at risk (Alexander, 1991; Granger, 1999; United Nations, 2012, p. 7; Sayers et al., 2013). Risk can also be understood as a factor of the probability of the phenomenon and its consequences (Parliament, 2010; Scottish Environment Protection Agency, 2012, p. 14). A quantitative description of flood risk emerges from the interaction of hazard and vulnerability (Merz et al., 2010a; e.g. Parliament, 2010; Scottish Environment Protection Agency, 2012; Kelman, 2002; Merz, Kreibich and Lall, 2013). Sayers, Hall and Meadowcroft (2002) explain that whilst two risks can have the same calculated values, different mitigation plans might be needed depending on whether the risk is dominated by high vulnerability or a high hazard. This suggests that risk can increase if the probability remains the same but the consequences increase (e.g. if more assets are located in the flood risk area) and vice-versa. Figure 2-1 presented a summary of the most common definitions of risk.

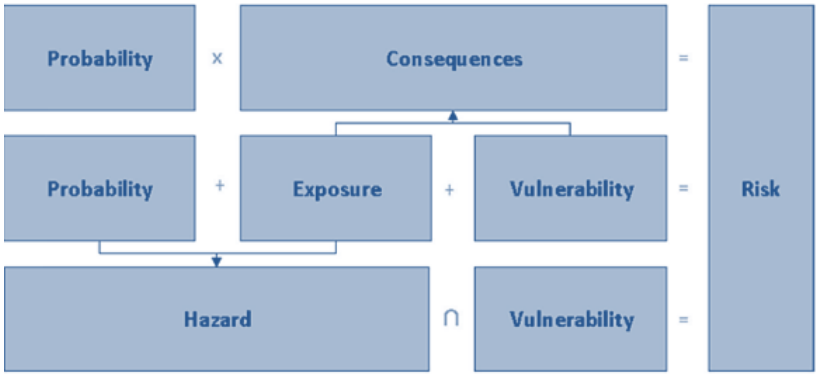

Figure 2-1 Flood Risk as a function of probability and consequences adopted from Klijn et al (2015)

In the following section, the concept of hazard and vulnerability at the property level, and the types and categories of data commonly used for that purpose is reviewed.

2.2.2.1 Hazard

Hazard is the potential occurrence of an event (in this study flood) that may cause adverse effects on human lives (Merz et al., 2010a). Flood hazard is characterised by the possible chance of occurrence (probability) and characteristics of flood events. It is important to discern the differences in the different type of flooding for some flood types are more manageable or preventable than others. At the property level, this can change the estimation of the damage of flood and the benefit of uptaking different mitigation options (PAS64, 2013). For example, according to ABI, protecting property against shallow flash floods can cost between £2000 and £6000. To keep water out during periods of prolonged flooding requires bigger changes which can cost between £20000 to £40000 (Bennett and Edmonds, 2014). Data about hazard is used to inform the damage functions and selection of mitigation measures and strategies. Based on its source (Sterna, 2012; EA, 2009a), flood can be:

- **Fluvial (river)** which occurs when the natural watercourse fails to transmit water downstream leading to excess water run-off the banks. River flooding is often predictable since it happens slowly and it takes time for the rain to percolate through the ground and into the river. This gives enough time for the forecasting tools to analyse and issue a warning.
- **Coastal floods** are caused by the sea level rise. This can be triggered by high tides, storm surges, waves overtopping and breaching sea defences or a combination of these factors. This usually happens when the storm wind pushes the water up and creates high waves.
- **Pluvial (surface water**) can occur following an intense downpour of rain when the drainage system becomes saturated and the land cannot absorb the excess water. In this type of flooding, the route the water takes and the depth of flooding is difficult to predict and depend on the local features.
- **Sewer flooding** occurs when the sewer system becomes overwhelmed due to heavy rainfall. The likelihood and severity of this type depend on the capacity of the local sewerage system.
- **Groundwater** happens when the groundwater level rises above the surface level. It is more common in the areas of chalk, limestone or aquifer. This type of flooding usually occurs days or weeks after a heavy or prolonged rainfall and can take a long time to recede depending on the land geology.

Other flood variables that can affect property include speed (Becker, Johnstone and Lence, 2010), frequency, depth, and duration of the event (Penning-Rowsell et al., 2005; DCLG, 2007; DEFRA and EA, 2008a; DCLG, 2010; Grant, Gillibrand and Hendel-Blackford, 2011). Amongst these characteristics, depth of flood is generally considered as the most common characteristics to be considered when assessing detailed flood damage and loss to residential properties studies in the UK (Kelman, 2002). Factors such as flow velocity, sediment load, duration, availability of flood warning are also recommended to affect the level of damage in that scale (Smith and Ward, 1998; Nicholas, Holt and Proverbs, 2001; DCLG, 2007; Kreibich and Thieken, 2008). Other characteristics such as the velocity of floodwater or sewage and water contamination are

considered to have a less important role in the estimation of the level of damage to buildings and cost of repairing following the flood event (DCLG, 2010).

2.2.2.2 Vulnerability

The vulnerability is the function of the system's sensitivity and capacity for response to the hazard. In the context of flooding at the property level, the examples of vulnerability can be viewed as the tendency of the particular house to be harmed during the flood, harm which can be physical or social-economic (Kelman, 2002; Alexander, 2013). Vulnerability can be the result of the three functions: (i)susceptibility: the harm that results when a receptor is flooded, (ii) resilience: the ability of a receptor to autonomously recover from a flood and (iii) value: an agreed means of quantifying the harm to a flooded receptor (Sayers et al., 2013). Although studies have suggested that social vulnerably can play a significant role in understanding the property level vulnerability to flood (Tapsell et al., 2002; Blaikie et al., 2014), in practice data used by the stakeholders for calculation the risk at this level, is normally physically-oriented (Alexander, 2013). As noted in Section 1.4, the focus of this study is on physical flood vulnerability of the domestic properties.

The literature on vulnerability recognises that individual properties are different both in their degree of risk (damage) when exposed to hazard and their capability to cope with the impacts of hazard. Figure 2-2 demonstrates an example of how individual building characteristics can alter the risk to a property. Without property level data this house would be regarded as being of similar risk to the one next door where the entrance and air vents are at pavement level.

Figure 2-2 An example of the effect of individual building characteristics on flood vulnerability (Author's own)

Information on the materials used in ground floors and walls seems to be of most recommended in the dwelling flood risk assessment literature (Escarameia, Karanxha and Tagg, 2006; Flood Repairs Forum, 2006; ABI, 2009), however the number of studies that are based on laboratory experiments is limited, and the basis of classification systems for rating the materials is not always clear (Escarameia et al., 2012). The different building component classification is given in Technical Bulletin 2 of FEMA includes structure, finish, insulation and apertures (e.g. doors, windows). The UK has also taken important steps in the

categorising the building materials and components (wall and floor) based on test protocols developed for different characteristics of flood water such as depth and duration. A laboratory investigation of the seepage and drying characteristics of mass concrete slabs was carried out by HR Wallingford for various arrangements of domestic house floors in the DCLG (2007) study, which was commissioned by the government. In a study on developing an adaptation cost curve for the UK residential buildings Grant, Gillibrand and Hendel-Blackford (2011) used three categories of building elements as floor, walls and interiors. Associate British Insurers (ABI) published the estimated cost of flooding to the residential properties based of the cost of repair on physical characteristics of the building including external walls, internal walls and cavity walls, floor finishes, doors, period features, services and staircases (ABI, 2009). Other commonly used characteristics include building typology (Schwarz and Maiwald, 2008; Grant, Gillibrand and Hendel-Blackford, 2011; Penning-Rowsell et al., 2005) and mitigation measures (EA, 2012; ABI, 2012).

Following the definition of risk as a factor of hazard and vulnerability, as noted in section 1.1, this study uses the term Property Level Flood Risk Data (PLFRD) to address any such data that are used for the purpose of risk management and mitigation in residential properties.

2.3 Managing flood risk in England

Any activity that is done for the purpose of analysing, assessing, reducing and altering the factors combined in assessing risk is called risk management (Parliament, 2010). Between the 1970s and 1990s, the flood risk management approaches were dominated by the hazard-based approach with a focus on flood defences and river management (Penning-Rowsell, Johnson and Tunstall, 2006). With its emphasis on controlling the hazard, in this method, the intention was to minimise the hazard by reducing its probability of occurrence using flood engineering solutions such as dams and levees. However, the limited focus of this approach to design a specific system for a specific hazard constrained the economic options and the scale of response (Sayers, Hall and Meadowcroft, 2002; Lafinhan, 2016). Consequently, reinforced by a progressive improvement in the quality of flood risk analysis and decision support available at a range of scales (Merz et al., 2010a), there was a shift of attention towards a more comprehensive solution.

In the 1990s, Flood Risk Management (FRM) was introduced. It advocates ‘living with floods’ and ‘flood resilience’ began to include an understanding that vulnerability had to be managed alongside the hazard (Merz et al., 2010b; DEFRA, 2004). In contrast to the traditional approach, individual and community vulnerability plays a significant role in FRM, and hazard should be interpreted in the presence of a vulnerable community (Brown and Damery, 2002). This was accompanied by the introduction of multi-tier risk analysis and adopted damage assessment to promote evidence-based decision making (Merz et al., 2010a; Porter and Demeritt, 2012; Merz, Kreibich and Lall, 2013). In recent years, FRM has moved even further from fragmented views towards taking a more holistic approach and complemented or replaced the physical flood defence with mitigation measures such as flood warning systems, spatial planning regulation, flood-proofing of buildings or insurance solutions (Merz et al., 2010a). This has entailed a change in the different aspect of managing flood risk.

A number of guidelines and standards have described the FRM cycle and its details (e.g. DEFRA, 2000; Hall et al., 2003; EEA, 2011; EU flood Directive mentioned in Thieken et al., 2014) commonly suggesting three key components to FRM (i) stakeholders, (ii) data and information and (iii) modelling and risk analysis. An overview of the FRM concept is schematically illustrated in Figure 2-3. Each blue rectangle represents a key component.

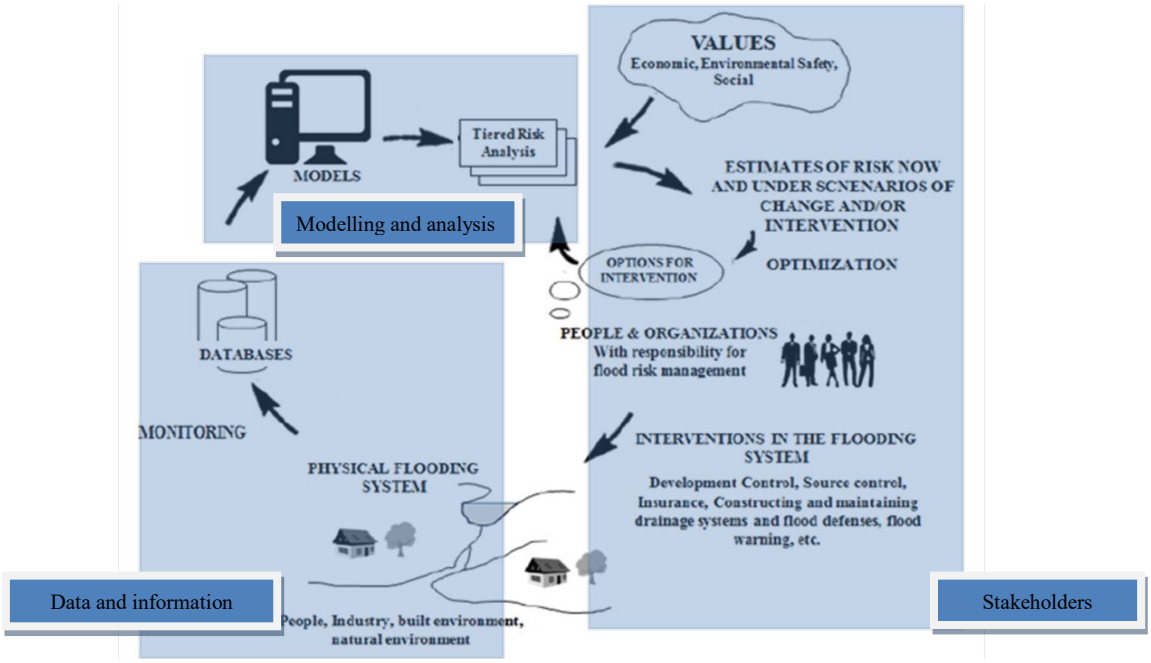

Figure 2-3 Flood risk management cycle adopted from Hall et al (2003)

The role of the flood risk management cycle components and the change they undertake following the shift in managing flood risk approach is discussed in the following sections:

2.3.1 Stakeholders

FRM can only be achieved when the relevant authorities, agencies, and people are aware of the intervening risks so that they can evaluate, mitigate, and respond appropriately to the risks (Thaler and Levin-Keitel, 2016; Lummen et al., 2016; Parker, 2000; Kundzewicz and Takeuchi, 1999). In this study, these groups are referred to as FRM stakeholders. Similar to other areas of environmental management, e.g. river basin management and urban development, stakeholder involvement is essential for effective and sustainable implementation in FRM (Abbott, 2007; Pitt, 2008; Steinführer et al., 2008; Watson et al., 2009).

In its broad definition 'stakeholders' refer to those who influence the decisions and those who are affected by them and can take actions that may be taken to manage the risk (Hall et al., 2003; DEFRA and EA, 2006b). A common set of stakeholders in managing natural disasters in the built environment, at the property level in specific, can include every household, property owner in the management area and indeed a much wider degree of government and institutional or organisational groups, such as water management companies, emergency relief organizations, spatial planners and development control, architects, and product suppliers, contractors, suppliers, financial institutions, insurance companies and affected local communities (DEFRA, 2010; Mojtahedi and Oo, 2012).

In a more exclusive definition, to avoid excessive complication, stakeholders are often narrowed to groups with one or several specific qualitative characteristics (Driscoll and Starik, 2004; Haigh and Griffiths, 2009). These characteristics often include the power to influence the system, legitimacy of relation to the issue and urgency to respond to the issue. The collective possession of all three characteristics gives these stakeholders managerial priority, a status which is known as the 'definitive stakeholders' (Mitchell, Agle and Wood, 1997). In the concept of property level flood risk management in the UK, the definitive stakeholder includes government agencies, insurers and the property owner (DEFRA and EA, 2006b; Penning-Rowsell, Johnson and Tunstall, 2006; DEFRA, 2010). Their roles and characteristics are discussed in further detail in the next chapter. Table 2-1 summaries the changes in flood risk management stakeholder role between the 1970s–1990s and the1990s onwards in five areas.

Table 2-1 Shift in flood risk management stakeholder role since the 1970s

Area of change	Flood defence approach (1970s–1990s)	Flood risk management approach (1990s onwards)
Multi-stakeholder participation	Decision-making should be taken by experts and elites. National responsibility to manage floods.	Advocating multi-stakeholder involvement in decision making. Combination of national and individual self-help required to manage flood risk.
Government's role	Flood control is predominantly the state's responsibility.	Protect and enhance the natural and human environment. Encourage public self-help through the market for insurance and protective products. A balanced approach between self-help and state-help in FRM.
Government power distribution	Flood defence policy should be determined by Central Government and applied by regional and local government authorities and other local operating authorities.	Proper distribution of authority among levels of Government. Active participation of all stakeholders and communities, local Government and national Government. National Government should provide policy guidance. Local Government has the key role in the implementation.
Role of society	Technological optimism in the ability of society to defend people and property against floods.	Society cannot prevent all floods but it can learn to manage, and live with, the risk.
Role of flood insurance	As an adjunct to flood policy, with the insurance industry providing a safety net for householders and businesses affected by flooding.	Insurance plays an important factor in addressing hazard and vulnerability.

Adopted form Penning-Rowsell, Johnson and Tunstall (2006)

Since the 1990s, one of the key changes in the role of stakeholders in FRM was promoting multi-stakeholder engagement in risk management at different scales. This is often suggested to correspond with a wider shift in the UK government economic and political approach to what is often termed neo-liberalism (Castree, 2008; Penning-Rowsell and Johnson, 2015) and advanced liberalism (Rose, 1996). Whilst the central government remains involved in steering decision-making and delivery, a greater emphasis was made to empower stakeholders notably the local authorities (see Section 3.3) and joint responsibility of a number of actors. Similarly, individuals and communities were expected to increase their degree of autonomy in understanding and managing the risk through increasing '*self-reliance'* and *'self –protective-behaviour'* has been widely promoted (Penning-Rowsell, Johnson and Tunstall, 2006; Pitt, 2008; Merz et al., 2010a; Kuhlicke et al., 2011; Alexander, 2013; Thaler and Priest, 2014; Thaler and Levin-Keitel, 2016). Their roles are further discussed in section 3.4.

2.3.2 Modelling and analysis

Flood risk analysis provides a rationale for appraisal of risk management decision options, allocation of resources and monitoring the performance of management solutions (DEFRA, 2010). Traditionally, the approach to flood defence (during 1970s–1990s), modelling and analysis was focused on reducing or eliminating flood hazard and to control or reduce it through decreasing the probability of occurrence and intensity of flood discharges (EA, 2003; Tunstall, Johnson and Penning-Rowsell, 2004; DEFRA and EA, 2006b; Porter and Demeritt, 2012). However, in the flood risk management approach the emphasis is on flood risk, where risk is defined as expected damage with a certain probability in a certain timeframe (Merz et al., 2010b). Therefore, damage aspects need to be taken into account in any deliberations on flood risk management. The concept of measuring damage to estimate the consequence of flood risk is well established (Smith and Ward, 1998; Merz et al., 2010b; Penning-Rowsell et al., 2013). Damage can be categorised into two broad types: direct and indirect damage. Direct damages cover those caused by immediate contact of flood water with people and properties or other objects. Indirect damage refers to the additional financial losses caused by flooding such as loss of utility and temporary evacuation. Each category can be sub-divided further into tangible and intangible damages i.e. direct tangible and direct intangible damage (Smith and Ward, 1998; Merz et al., 2010b; Penning-Rowsell et al., 2013). Those direct and indirect damages that can be specified in monetary terms are tangibles e.g. damage to building fabric and the cost of clean-up. Those that cannot readily be valued but can be referred to in qualitative or quantitative terms are intangible mainly including the health impact and social vulnerability (Soetanto and Proverbs, 2004). Table 2-2 demonstrates some example of tangible and intangible flood damage type at the property level.

Table 2-2 Typology of flood damage

		Measurement	
		Tangible	**Intangible**
Form of damage	**Direct**	Damage to building fabric and clean-up cost	Loss of personal belongings
	Indirect	Absence from work	Inconvenience of post-flood recovery

Adopted from Penning-Rowsell et al. (2005)

The direct and indirect flood damage can also be classified in terms of primary and secondary damage according to their significance to a particular sector (Smith and Ward, 1998; Dutta and Herath, 2001; Messner et al., 2007). The risk as the basis for FRM decisions, has become widely operationalised through modelling and quantified analysis risk (Mertz (Merz et al., 2010a; Hall and Solomatine, 2008) that is based on flood damage analysis (Messner and Meyer, 2006). At the property level, stakeholders can adopt different damage estimation procedures depending on their aims and the availability of source data required. These methods can be broadly categorised as:

- **Post-event damage estimations** are adapted to calculate recovery and reconstruction costs and estimate the effect of floodwater on building after a flood (Notaro et al., 2013). At this stage, it can be a quick estimation right after the event or a detailed survey to estimate the recovery and drying cost, and the introduction of possible mitigation measures before starting the recovery actions. The types of data that are collected and used at the property level at this stage are specific to the investigated area and building. This type of damage estimation is mainly used by the insurer, however, the public sector also uses the figures generated during this processes to support prioritising the allocation of funding and aiding affected individuals and assessment of future risk potential (DEFRA, 2010).
- **Pre-event damage estimations** assess the expected damage for a potential flood scenario. The internationally accepted standard approach to estimate direct monetary flood damage is damage functions (Kelman and Spence, 2004; Meyer and Messner, 2005; Merz et al., 2010b; de Moel and Aerts, 2011; Green, Viavattene and Thompson, 2011; Penning-Rowsell et al., 2013). Damage curves are also used to estimate vulnerability (Jongman et al., 2012). Damage functions can be different in spatial scale, damage classes and the number of flood characteristics included. At the property level, the flood damage functions specify the level of damage based on the dwelling characteristics e.g. land use, age and type with respect to hydraulic characteristics of flood e.g. depth, a combination of depth and velocity, or duration (Dutta and Herath, 2001).

Availability of suitable data plays a significant role in the selection of analysis method and modelling (Dutta and Herath, 2001) and can affect the degree of precision of the outcome of the models, complexity of analysis, and amount of effort required (Messner et al., 2007; Merz et al., 2010b; Hammond et al., 2015). The next section reviews the role of data and information in further detail.

2.3.3 Data, information and knowledge

Data relating to different aspects of the drivers of the risk and their effects are necessary for effective risk management (Kelman, 2002; Merz Kreibich and Lall, 2013). Data and information obtained from risk modelling and analysis enable the stakeholders to evaluate the risk and decide for the most suitable risk management solution. The terms data, information and knowledge are often used interchangeably in different studies. The Audit Commission (2007), defines ‘data’ as the basic facts that form information and build knowledge including numbers, descriptions or images collected for a particular aim. It should be noted that data characteristics as the basic fact can be blurred as soon as one tries to interoperate it. Carlson and Anderson’s (2007) suggest that Data are, entangled’ with the conditions of their production such as why they

the data were collected, by whom, from whom, under what conditions and with which tools which must be taken into account when interpretations are made. 'Information' however, is obtained through processing, manipulating and classifying data. Information considers the presence of a sender of information and receiver and that, if the communication is effective, there is a change in the way the receiver perceives something. Information refers to an objective closed set of data, related to the consequences of possible events, then knowledge, on the contrary, represents an open subjective set resulting from the individuals' interpretation of the information, according to their cognitive models (Fransman, 1998). Information is then passed on to individuals and creates knowledge when relevance and context are included and brings insights to the information. Knowledge is a complex structure, based on experience and consisting of a system of action rules that determine the meaning and the utility of the information (Langlois, 2001),. Therefore, knowledge can be seen as '*a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information*' (Davenport and Prusak, 2000, p. 5). The relationship between these three can be described as, in the context of a specific body of knowledge that data can be interrogated and create information (Brown and Duguid, 2000). There are different categories of types of knowledge, classifying it into explicit and tacit knowledge is a commonly used one. Whilst the explicit knowledge is available in a physical format such as text and photos and hence, transferable and reusable, Tacit knowledge is stored in the mind of individuals. Other forms of classification of knowledge can be based on organisations (internal and external knowledge) or its association with the number of people (individual and shared knowledge), all of which can be adopted separately or in combination to one other, based on the desired knowledge management activity or intervention.

This study adopts the term 'Property Level Flood Risk Data (PLFRD)' to refer to data used by key FRM stakeholder groups in England (discussed in Chapter 3) at the domestic property level for the purpose of managing tangible effects of risk, that has the capacity to be captured in a physical format and can be communicated and transferred. This excludes use and availability of information and knowledge which is more challenging for the purpose of reusing and transferring amongst different stakeholder. The scope of this study does not include commercial properties and indirect and untenable risk (such as social and commercial aspects of risk) to dwellings. The reason for this exclusion is that tangible risk data at domestic level has a wider presence of evidence with regards to its use and availability in the literature of FRM at this scale. The existence of a common history of the key stakeholder engagement in the tangible risk at the domestic scale also facilitates a deeper investigation of the issue. This is discussed in more detail in the next chapter.

Understandable, accessible and fit-for-purpose flood risk information provides the foundation for an effective flood risk management system (DEFRA, 2011a) and is fundamental for evidence-based decision making and justifying stakeholders' investment (EA, 2010). FRM starts by monitoring the flooding information which is obtained from the present and past performance of the system (including the flood and the receptors). This information is stored in a database and is used to develop models of the system performance.

In the UK, since 2000, there has been a substantial improvement in risk mapping and data due to the development of advanced computing and data science technologies. The first national flood risk map was initiated by the National Rivers Authority in 1994 (DEFRA, 2011b). However, it was not until 2000, that the first web-based flood map was published. Following that in 2003, the EA published its first Flood-Zones

maps to meet the requirements of Planning Policy Guidance 25 (later National Planning Policy Framework). Whilst the EA remains an important provider of flood risk information, the number of sources of flood risk information has been increasing considerably following the Flood and Water Management Act 2010 and the Flood Risk Regulations 2009 (see Section 3.2).

The improvements in flood risk mapping were influenced by private data providers. For instance, AVIVA conducted a two-year mapping project in 2002 which resulted in the largest and most accurate digital map at the time in the UK for insurance purposes. Since then they used the information generated from the flood map to accurately evaluate flood risk for individual customers and a better understanding of flood risk to individual's property (Aviva, 2002; Aviva, 2004a). Another example is JBA Counselling which is an important commercial provider of national flood risk maps in the UK incorporating site-specific topography and simulated rainfall of various intensity and river flooding in their datasets. Other examples of commercial data providers are the British Geological Society and the Ordinance survey. Table 2-3 summarises the shift in the role of data in flood risk management between 1970s–1990s and the1990s up until now in two main categories.

Table 2-3 Shift in role of data in flood risk management since the 1970s

Area of change	Flood defence approach (1970s–1990s)	Flood risk management approach (1990s onwards)
Information, knowledge and education	Information is dominated by elite opinion. Single directional education with knowledge and information generated by 'elites' and passed to the 'public'.	• Elite and public knowledge both important. • Multidirectional spread of knowledge, information and education.
Risk communication	Focus on return periods and probabilistic understanding of risk (Hazard). Risk is not communicated to all stakeholders but retained as expert knowledge.	• Effective communication of risks, consequences, and uncertainties between all stakeholders is paramount. • Emphasis on local knowledge of risk.

Adopted form Penning-Rowsell, Johnson and Tunstall (2006)

In contrast to traditional flood defence approach, FRM alongside hazard, places more emphasis on individual and community vulnerability. In the traditional paradigm of managing risk, scientific knowledge and its objectivity are perceived to be crucial to identify and manage environmental issues. In this paradigm, knowledge is divided between experts and the general public. The former understands the risk as it really is, whilst the latter merely perceive a distortion of actual risk. As the consequence, experts' exclusive access to data on hazard and its magnitude led to promoting 'technical fix' to reduce risk (Brown and Damery, 2002; Penning-Rowsell, Johnson and Tunstall, 2006) which explains the technocrat- oriented culture of the Environment Agency. In contrast, FRM approach argues that due to a large amount of contextualised and locally embedded information, the general public are experts in their own right (Szerszynski, 1999), and what was once perceived as a clear division between experts and public knowledge is now understood to become increasingly blurred (Irwin, 2002; Penning-Rowsell, Johnson and Tunstall, 2006).

Several attempts have been made to bridge the gap between expert and lay knowledge. A step towards making 'expert' flood knowledge more usable for the public was the Freedom of Information Act 2000 (FoI) which came into force in 2005, creating a public right of access to information held by public bodies. Under

this Act, property owners can inquire for available flood information from the EA or the local authorities. The UK 'Open Data' initiatives similarly intended to facilitate wider data availability and reuse of public sector information. Under the Open Government Licences, the EA has opened up the Risk of Flooding from River and Sea database (Linford, 2016) with the aim to use the best available information wherever possible. However, success has been partial. As Haughton, Bankoff and J Coulthard (2015) argue there is still tendency to label some form of flood knowledge into specific categories such as local, lay, expert and scientific. This will present the knowledge as having qualities that are somehow fixed, definite and worth favouring.

2.4 Evidence in support of use and accessibility of PLFRD

At the international level, there are several frameworks explicitly calling for the collection and analysis of data in response to an improvement in risk management. For example, in 2011, the Science and Technical Committee of the United Nations International Strategy for Disaster Reduction (UNISDR) highlights the need for review and linking of the various disaster information sources and databases to improve the consistency, comparability, quality assurance and value of the data available at different scales (Kar-Purkayastha, Clarke and Murray, 2011). The Sendai Framework for Disaster Risk Reduction 2015–2030 calls for data collection of disasters including climate change-related risk at all scales with a focus on factors such as affected individuals and economic loss (Serje, 2017). It calls for closer collaboration between all sectors for better risk management. The available international disaster databases often host data relating to damage. They often host aggregate and generalise data by disaster, sectors and regions. Examples are the Munich Re's NatCat database (Kron et al., 2012) and Emergency Disasters Data Base (EM-DAT). Review of the publically available regional and country-level database in Australia and HAZUS in the United States (Tschoegl, Below and Guha-Sapir, 2006; UNDP, 2013) similarly suggested that the focus of collected data for hazard modelling was to support planning and national decision rather than calculating risk at the micro level (Molinari, Menoni and Ballio, 2017). It is suggested that these databases are significantly different in coverage, detail and quality of data and at this scale; object-specific databases are rare (Kreibich, 2017).

Examples of object-oriented flood risk databases can be found in a number of research projects. However, often there is insufficient evidence on whether and how the databases are used outside the academic world, specifically by the risk management stakeholder groups as a source of information to assess the risk to individual properties. For example, HOWAS21 is a flood damage database for Germany, established in 2007. It was based on HOWAS-Database 1978-1994 (Merz et al., 2004). It contains object-specific data focussed on direct tangible damage including an attempt to harmonise information about flood impact, exposure and vulnerability. It included the effects of the pluvial and fluvial floods across different classifications of the objects including residential properties. The collected data was intended to be used to derive loss estimation models and support pre and post-event analysis targeting a range of users with various needs (Elmer et al., 2007). It defined three categories of user groups to form various levels including restricted access to generalised data for the international viewer. One of the main issues that the project faced was a low level of interest amongst the organisations to share their data and contribute to the database. Another issue was the high number of errors, leading to significant uncertainties in modelling loss (Kreibich et al., 2017). Another example in European initiatives was the Improving Damage assessment to Enhance cost-benefit Analyses

project (IDEA) 2015-2017. It was conducted in response to concern regarding the low quality of available data used to evidence the benefits of mitigation measures from the economic perspective. It used three case studies including Umbria storms, the Lorca 2011earthquake, and the UK 2007 floods. The already available data were used for detailed risk analysis including understanding the hazard intensity, vulnerability and exposure. The findings of the project suggest that there is great heterogeneity of data between the data collector stakeholders groups. A significant issue in limiting data reliability in government data was suggested to be caused by lack of a singular institutional figure at the local level, responsible for collecting and managing disaster loss data which can be merged at a national level database. It was realised that despite this issue, the currently responsible offices were uninterested in getting a comprehensive overview (Molinari, Menoni and Ballio, 2017).

At the UK level there have been a number of regulations and recommendations (see Section 3.2.1), as well as initiatives to improve the use and availability of flood risk data in general, and PLFRD in specific. Examples are SWIM Flood Data Tool and the BRE Property Flood Resilience Database (PFR-d). SWIM online Flood Data Tool is a dataset that was developed by Dorset County Council to improve flood data collection, communication and record management to be used by members of the public and flood risk management authorities (swim.geowessex.com, no date). PFR-d goal is to collect data on property level protection and resilience measures in a way that they can be integrated into insurers system. This database will be discussed in further detail in chapters 6 and 8.

One of the most influential initiatives in the improvement of flood risk data availability and quality was the Pitt Review Report. This report is regarded as a key step towards flood data sharing and communication. Following the 2007 flood in the UK, the government commissioned Sir Michael Pitt to carry out a review of the country's flood defences. The report expressed huge concerns about the absence of clear coordination and prioritised risk management and identified the need for a clearer understanding of what data is needed, who is responsible for providing it and when. In summary, the report put forward 92 recommendations for reshaping the flood management practice of the country to a more integrated approach to FRM, and flood risk mapping and forecasting; and empowering local risk management through sharing information and cooperation of different stakeholders (Pitt, 2008). In 2012, the Department for Environment, Food & Rural Affairs (DEFRA) published a progress report suggesting that from the total number of 92 recommendations, almost half of the recommendations were implemented by 2012 and the rest were subject to ongoing work or due to completion. Of these recommendations, only three are not due to be implemented.

The 2007 floods followed by the Pitt review 2007-2008 which influenced the future changes in the UK flood risk management, for instance, the improvement of local flood risk management (DEFRA, 2017), development of the FWMA 2010, and National Flood and Coastal Erosion Risk Management Strategy 2011 (DEFRA, 2012c). During the data collection phase of this study, the Pitt Review was similarly suggested as the most influential in the formation of the property level flood risk recommendations made during 2010 and 2011.

In addition to the examples presented above, between 2010 and 2011 the UK government has published three documents that specifically addressed the need for improvement of flood risk data at the property level.

These documents include DEFRA 2010 *Availability and Uses of Property Level Flood Risk Data and Information*; DEFRA 2011 *Flood risk and insurance: A roadmap to 2013 and beyond*; and EA 2010 *Flood and Coastal Risk management Risk Mapping Strategy.*

2.4.1 DEFRA 2010: Availability and Uses of Property Level Flood Risk Data and Information

In 2009, DEFRA with the support of the Environment Agency (EA) commissioned a study to evaluate the use and availability of data in regard to flood risk and mitigation information at the property level, and subsequently to provide recommendations for future actions to improve collection and use of such information (DEFRA, 2010). It acknowledged the prime motive for the development of PLFD was the improvement of flood risk data held by the government and the insurers. This included the EA flood assessment products and national online fluvial and tidal flood risk maps, national address property dataset 2008 and data held by water companies. For the insurers, improvements in claim recording and modelling flood risk data, pooled with the increase in claims activity has emphasised the commercial significance of informed flood risk evaluation and underwriting. There has also been a growing interest from communities and individuals to understand the potential current and future risk to their homes so that they can choose suitable measures to protect their properties. Additionally, previous major flood experience such as the 2007 floods suggested that collecting property level flood risk data such as location and characteristics of the building offers several important benefits for supporting post-flood recovery and estimating pre-event risk.

Hence to evaluate the current state of such data and identify areas for improvements, between December 2009 and February 2010, structured telephone interviews with interested stakeholders, literature review and one workshop with those who had interests in the FRM and use of PLFRD was conducted. The study recognised that there is considerable diversity of sources of information availability, accessibility, quality, and level of detail of PLFRD products held amongst the stakeholders. The study suggested several barriers to facilitating the wide availability of PLFRD. Example of these barriers includes the awareness and understanding of the data, the commercial sensitivity of the data, costs of data collection, data protection and liability issues, licensing arrangements, fear of property blight, and concerns over the accuracy and reliability of the available information. It was suggested that there is a consensus amongst the users that there is a need for more detailed flood risk information than what was available at the time. It was anticipated that such need will increase significantly in the future driven by, for instance, the pressure of climate change, legal requirement and agreements such as the Flood Directive 2007 (see Section 2.1.2) and Flood and Coastal Risk management Risk Mapping Strategy 2010 (see Section 2.4.3).

Eventually, 16 actions were proposed to assist with the improvement of accessibility, use, collection and management of PLFRD for the period of 2010 – 2015. Bringing together stakeholders (notably Government and insurers) to exchange information and knowledge; improve risk understanding and awareness through the provision of information; reducing conflict and promoting cooperation (see Appendix C for the complete list of recommendations). Examples of recommendations for future actions include:

- *Finalisation and active use of a consistent survey method/template for the survey/loss adjuster and insurance industry... This template should be designed to capture more consistent property level flood risk assessment* (DEFRA, 2010, p.63).

- *Encouragement for the insurance industry to adopt a standard format for the future collection of information relating to household and commercial claims* (ibid, p.63).
- *The benefits of doing this [property level flood resilience and resistance uptake] should be passed on to the property owner in the form of reduced insurance premiums* (ibid, p.4).
- *The Environment Agency should provide links from insurance company websites to the Environment Agency or another commercial equivalent as a way for residential and/or commercial policyholders to assess property level flood information source* (ibid, p.55). *Improving the accessibility and use of property level flood risk information* (ibid, p.72).
- *Development of report tools relating to property level flood risk data which are relevant to the needs of users* (ibid, p.60).
- *Encouragement of local authorities to supply details of the location of previously flooded properties to the Environment Agency* (ibid, p.66).
- *Education is required to inform property owners of solutions to minimise the impact of flood events… Solutions and benefits should be communicated in plain English and case studies of success stories presented showing how measures can be funded (and associated costs)… Information on flood risk should form part of the information provided by developers with a new property in flood risk areas* (ibid, p.45).
- *[for engaged parties to] Finalise the scope and licensing arrangements for sharing of non-sensitive information between professional partners* (ibid, p.66). *Licensing large datasets entails a large cost, which has to be weighed upon a cost-benefit basis* (Ibid, p.44).

For each action, suggested involved organisations, possible barriers and the long-term benefits were outlined. It was suggested that the responsibility for delivering these actions was mainly on government agencies, with support from consulted stakeholders. DEFRA 2010 was optimistic that in the future changes including Flood Risk Regulation 2009 (see Section 3.2.1.2) the Floods and Water Management Bill (it later received Royal Assent and became an Act of parliament in 2010, see Section 3.2.1.3), EA FCRM Risk Mapping Strategy 2010-2015 (see Section 2.3.4.3) insurance industry performance, climate change pressures and personal interests in accessing property level information will promote the availability and use of PLFRD.

Although the data collection process was conducted in a relatively short period, DEFRA 2010 succeeded in presenting a rather comprehensive awareness of the available datasets and databases used by the stakeholders up to that time. Based on its findings, DEFRA 2010 suggested a wide range of stakeholders demanding property level flood risk information in the areas of FRM for several purposes. However, the relationship between stakeholders and how it can affect the communication of data between them was not made clear.

Often for individual recommendations, multiple goals existed. The majority of the recommendations included the possible barriers that could hinder the implementation. Yet, for some recommendations, the statement of the recommendations and the future action often failed to propose possible solutions to how associated foreseen barriers could be addressed in the course of implementing the recommendations. For instance, in implementing the recommendations regarding data sharing between LLFAs and the EA, no clear approach was suggested to address the barriers caused by diversity and variety of local authorities and their approaches

to data, including the pressure of scarce resources amongst local authorities for gathering more data. Another example was that whilst DEFRA 2010 mentions that commercial concerns can be a barrier for the insurance industry to share their data, the document did not present any clear evidence of how that can affect standardisation of data collection and dissemination. Similarly, it was not made clear whether or how such standardisation could be used by the insurance industry for pricing purposes in practice. For example, recommendations regarding the creation of a standardised template for data collection and storage can be beneficial only if there is a desire for exchanging such data. Similar issues were evident for recommendations regarding the barriers of commercial concerns in sharing individual insurers' data with other insurers or with the government.

2.4.2 DEFRA 2011: Flood risk and insurance: A roadmap to 2013 and beyond

In response to the insurance industry's announcement of the termination of its agreement with the government (SoP 2013, see Section 3. 2), DEFRA formed a summit committee to discuss the challenge of flood risk insurance availability through collaborative work with other organisations. The committee comprised representatives from Government, the insurance industry and organisations with expertise or an interest in the issues being discussed. Three working groups were set up, each focusing on different areas of concern. These areas included (i) assessment of different options to manage the financial risks of flooding after 2013 with the aim of reaching a decision on the role of private insurance in the run-up to 2013 and beyond, (ii) improving the provision, availability, sharing, and transparency of flood risk information to all, (iii) and promoting the uptake of resistance and resilience measures that individuals could use to reduce their flood risk appropriately. Throughout this research, this document will be referred to as DEFRA 2011. In total DEFRA 2010 suggested 8 actions to ensure flood insurance remains widely available after 2013. Key actions relevant to the content of this are as follows.

The Data provision and Transparency Working Group highlighted the need for understandable, accessible and fit-for-purpose flood risk information to improve public engagement in FRM and assist insurers to price flood risk appropriately. This group identified a need for better communication of information between the EA and the insurers and the public. They also agreed on the need for ascertaining how localised flood risk information, including information on property-level protection, can be merged into insurers' underwriting systems. It required the Government to make flood risk datasets more transparent and accessible (DEFRA, 2011b). In order to reflect flood risk in insurance policy terms, the working group suggested that '*DEFRA [is required to commission a research project to look at incorporating localised flood risk information into insurers' underwriting and to set up a project board including members of Working Group 2'* (DEFRA, 2011b, p. 13). The next key topic discussed by this working group was the investigation of how insurers can share flood extent and claims data with the EA. Although it was acknowledged that this task can be challenging due to freedom of information and competition law concerns, it was suggested that '*the ABI [Association of British Insurers] and Environment Agency to continue to work together towards sharing flood extent and claims data'* (DEFRA, 2011b, p. 14). This task group had a debate on whether making UK national flood risk assessment datasets freely available to the public (similar to the US individual community flood risk maps) could potentially be beneficial. It was recognised that there are barriers such as licencing restrictions and possible negative impacts on private sellers of flood risk information. It was suggested that

having a more transparent and accessible flood risk datasets in a '*one stop shop'* (DEFRA, 2011b, p. 19) would assist with minimising confusion of the general public in obtaining the *'official data'* (ibid.). This was suggested for DEFRA and the EA *'to work together to make flood risk datasets more transparent and accessible' (ibid. p.20).*

Working Group 3 focused on the issue of customer experience and views towards property-level resistance and resilience by proposing several actions focused on developing an understanding of the impact of property-level measures. Amongst them, three were found to have a direct connection to the topic of this study. This working group suggested that the uptake of property level flood measures by the householders can be incentivised if such effort is recognised by their insurers. In order to do that, insurers need to be provided with sufficient confidence that firstly, these measures can reduce the effect of flood risk to the property, and secondly such effect is quantifiable in the calculation of the cost of the claims. Thus, an action seems necessary for '*ABI and BIBA to work with DEFRA to develop evidence around effectiveness and impact of property-level measures, so that these measures may be taken into account by insurers in the future'* (DEFRA, 2011b, p. 26).

The suggested actions in DEFRA 2011 are the results of regular meetings between the three working groups that comprised representatives from government, insurers and community groups, from December 2010 to July 2011. However, groups responsible for carrying out the actions were mainly the government (DEFRA and the EA) and the insurance industry representatives (mainly the ABI and BIBA). Additionally, the actions seem to be more explorative rather than conclusive. In some cases, indications regarding the likely barriers to implementation were suggested, however, often it was left upon as to the actions to find the possible solutions and investigate the way forward.

2.4.3 EA 2010: Flood and Coastal Risk Management Risk Mapping Strategy

As part of the Agency's 5-year planning strategies between 2010 and 2015, the EA published Flood and Coastal Risk management Risk Mapping Strategy 2010-2015 (FCRM) with the aim to ensure that the EA has quality data available at the right time to enable them to make evidence-based decisions (EA, 2010a). In this study, the term 'EA 2010'is used in reference to this document. EA 2010 developed three data strategies to set out the Agency's approach to data, modelling and mapping for the 2015 horizon. These strategies included (i) managing data, information and knowledge as assets, (ii) using data to inform evidence-based decisions, and (iii) improving understanding of flood and coastal erosion risk amongst the EA partners and the public. The implementation of these strategies was in response to the need for improving wider engagement of stakeholders and improve the way the Agency manage, share and present information on flood risk for easier and more intrusive communication.

To achieve these goals EA 2010 listed eight principles, each followed by a number of action plans to achieve these principles. Principle 4 of this strategy calls for consideration of '*a greater range of the impacts of flooding and coastal erosion, and the risk of flooding to a property level'*. This principle was developed in response to the requirement from the EA in Flood Directive 2007 (see Section 3.2.1.2) to investigate and develop preliminary flood risk assessment to understand the potential social, economic and environmental consequences of future flood risk. In addition to that, the EA had realised that the absence of property level

flood risk information causes the property owners to misinterpret the available data as being property-specific already. For that reason, the Agency suggested an assessment of the possibility of whether the Agency should be mapping to that scale. In that light, two correspondent actions recommended that the EA will:

> *A4.1 develop a dataset that will include information about the sites affected by flooding and coastal erosion, including properties, significant environmental sites and sites of cultural interest. This dataset will be the single source which we will use to understand the impacts of flood and coastal risk; (EA, 2010, p. 9).*
>
> *A4.2 investigates whether we [the EA] can realistically assess the risk to the property level in a cost-effective way, and, if so, determine whether we need to take a risk-based approach to the application of that method (ibid.).*

Two actions highlighted two of the key popular demands from the Agency: firstly, to develop a dataset that comprises information about exposed assets including properties to understand the impact of the flood, and secondly, to explore the cost-effectiveness of flood risk assessment at property level in comparison to the broad-scale risk assessment and to present a possible risk-based approach as a way forward. EA 2010 noted that the detailed plan to achieve these goals including possible cost or risk of detail specific actions and an implementation plan would be published for the Agency's teams and partners, rather than for public access. Therefore, in the lack of accessible supportive documents, it is challenging to critique this action plan. However, it is clear that unlike the first action the second action leaves the expectation for guaranteed outcome uncertain as it is expressed in a suggestive tone rather than a definite one.

2.5 Chapter summary and conclusions

This chapter provided an overview of the concept of flood risk management and the significant role of data and stakeholders in property level flood risk management was discussed. This study uses the generic term of 'property level flood risk data' to describe information and data used by risk management stakeholders on domestic properties in the UK. It was discussed that since the 1990s, the UK approach to managing flood risk shifted from flood defence to flood risk management. It called for a holistic approach towards risk management and increasing participation of a various range of stakeholders with emphasis on local scale engagement and notably, holding individuals responsible for managing their risk.

This chapter also defined risk and property level data used in this study as the reusable and transferrable data and information that is owned and utilised by the key stakeholder groups for the purposed of mitigating direct, tangible risk to individual properties at risk. Consequently, by using PLFRD is study excludes data and information regarding the indirect and intangible effect of risk at this scale, from this research.

On one hand, it is understood that data has a fundamental role in supporting stakeholders to predict their responses, adjust their resources and optimise their function for an effective flood risk management. At the property level, the potential consequence of flooding can vary depending on the different characteristic of hazard and vulnerability combination. Yet, on the other hand, during 2010 and 2011 it was suggested that the available data failed to support flood risk management at the property level. Therefore, clarification of the existence of property level data constitutes a gap in the existing literature and can be seen to provide a

potential contribution to knowledge. This issue was addressed by several government documents calling to improve the state of flood risk data at the property level, amongst them are DEFRA 2010, EA 2010 and DEFRA 2011.

In conclusion, the key issue of property level flood risk data at the time, addressed in these documents, notably, DEFRA 2010, DEFRA 2011 and EA 2010 can be categorised into three main key topics of concerns including:

i. **Data consistency and standardisation:** This category of recommendations was mainly focused on a recommendation for creating a standardised process for data collection and data dissemination between and within stakeholder groups notably the insurers and the government. Key stakeholder groups to carry out these recommendations include DEFRA, the EA and the Associate of British Insurers (ABI).
ii. **Data sharing and communication:** In this group, recommendations were made to a variety of data holders including the EA, local authorities, the ABI and individual insurers to facilitate the sharing of detailed risk data. A number of improvements were suggested comprising minimising the legal obstacles and tailoring the data specific for the use of stakeholders engaged at the property level. The aim was to enhance the understanding of risk and to provide a better knowledge-based choice for mitigation decisions.
iii. **Data supporting the effectiveness of property resistance and resilience measures:** The focus of this category was to encourage the uptake of property level flood resilience measure amongst the property owners through providing evidence of the effectiveness of these measures in reducing the expected damage to individual properties. The evidence of effectiveness was expected to incentivise the insurance industry to incorporate the adoption of such measures in their underwriting process so that eventually homeowners are more eager to take up a proactive role to protect their properties.

DEFRA 2010 and DEFRA 2011 had inputs from a range of stakeholders including government, insurers and the community representatives, and EA 2010 was directly formulated by the Agency. Although many of these individual recommendations and proposed actions are framed in a suggestive tone rather than a definite one, the repetition of similar needs and issues in these government documents suggests the significance of the topic under study. Similarly, the actions suggested in these government documents were produced with active engagement from the insurance industry representatives such as ABI and BIBA. Therefore, it is expected that these recommendations, together, provide a detailed view of a different aspect of the research topic which offers a good starting ground to further investigate the topic. Additionally, they revealed the need for property level flood risk data and the need for action to address this lack of information

The next chapter appraises the current levels of availability of PLFRD and ascertains to what level such data is used amongst key stakeholder groups. This chapter concludes by formulating the gap in knowledge.

Chapter 3: UK Flood Risk Management at Property Level

3.1 Introduction

In line with Objective 1(a) of this study, this chapter appraises the levels of availability and use of property level flood data amongst the key stakeholder groups in the UK. In the previous chapter, the need for property level flood risk data and the key stakeholder groups were identified. In this chapter, start with a historical review of the key events that lead to the current arrangement of the key actor's with regards to the FRM at the property level in England. These key stakeholder groups at property level are reviewed in detail and the availability and use of property level flood data amongst these groups, to the extent that was attainable from the literature, is studied. Finally, the gap in knowledge is articulated.

3.2 History of the key actor's involvement in FRM in England

The current policy discourse in England is the product of the deregulation practice during 1980s-1990s under Margaret Thatcher and Tony Blair institutionalisation to neo-liberalism policy in the 1990s (Peck and Tickell, 2002). With the introduction of the neo-liberalism framework into the policy process, the central state was encouraged to take part in sharing duties and responsibilities. Governance characteristics have also been influenced by the New Institutional Economics (NIE) that focus on private methods to enhance the economy, efficiency, and effectiveness of policy decisions (Bevir, Rhodes and Weller, 2003). This further introduces the role of the private market as an instrument into public administration to minimise the costs and increase efficiency.

Over the last three decades in England, the changes in the FRM system follows a selective pattern of decentralisation as it is defined in the governance theory which formed the modern flood governance in the country. This can be seen as moving away from privatisation with demonstrating collaborative characteristics in managing the risk. The change in the governance network can be mapped out through privatisation to the collaborative model in three stages. The first stage is prior to 1989 which can be marked as the pre-privatisation period. Up to this point, the state had taken responsibility for all water and sewerage related actions (Scrase and Sheate, 2005). Following the Local Government Act, 1972 Local Authorities underwent significant reorganisation in 1974 and was resized to a smaller local establishment. Under, Water Act, 1973 responsibilities for water handed to the National Water Authority consists of Regional Water Authorities with some flood risk management duties. Although the Water Act, 1973 intention was to merge all water organisations under the Water Authorities, the Independent Drainage Boards managed to keep drainage powers and consequently, FRM institutionally separated (Scrase and Sheate, 2005). At this time, the role of communities was diluted in voluntary organisations. Parker (1987) suggest that during this time, there was an absence of a clear national policy statement on FRM in England. In1979 Margaret Thatcher took the leadership of the Conservative Party, which later on pursued privatisation, which also affected the privatisation of the water industry in 19897 (Bakker, 2005). In the political economy debates about private and public relation, the public is defined as an open area with little excludability and competition, and private is implied as an exclusive area with private sovereignty (Cox, 2013). FRM privatisation was at its peak in 1989, as the Regional Water Authorities which had sewerage and sewage treatment role, were passed on to

the private sector. Other duties such as FRM remained with the government, controlled by the newly formed National Rivers Authority (NRA) (Water Act, 1989).

In the post-privatisation area, between 1990 and 2006, the outcome of privatisation and the pursuit of neoliberalism started to manifest through substantial growth in the private sector (Hall, 2011). In 1996 the environment department of central government went through a change; the National Rivers Authority was taken over by the EA (Environment Act, 1995). The EA became the principal FRM operating authority with the power but not the legal responsibility. Following the national election in 1997, the labour party made a transfer to the regional level and created Regional Development Agencies (Regional Development Agencies Act, 1998) as non-departmental public bodies. At the local level, in 2000, Local Strategic Partnerships were initiated to encourage joint working between the local, community and private sectors to address local problems, and better allocation of final resources and developing shared strategies and plans (Gaventa, 2004). Strategic funding suddenly made it clear how overcomplicated the water governance had become and the duties once done by the central government is now being distributed amongst a variety of governmental, private and voluntary institutes (Scrase and Sheate, 2005). Therefore the consequence of restructuring and privatisation was the emergence of further complex multi-level arrangement for governance. In a pluralistic democratic setting like England, the presence of complex distributing of power can lead to difficulties in implementing actions, which can delay the progress and negatively affect the development and implementation of policies (Ashworth, Snape and Aulakh, 2007). The 2007 floods, questioned the viability of this overly complex network of responsibility in flood risk governance system. Privatisation transferred not only water services but also expertise from local authorities to private companies (Bakker, 2005; DEFRA and LGA, 2008). Eventually, to address to the complex and potentially conflict-ridden process of FRM, flood risk governance in England adopted a collaborative arrangement for FRG to initiate a more effective and sustainable implementation (Pitt, 2008; White, Kingston and Barker, 2010). At the property level, this includes bringing together diverse groups of key actors. In the following sections the current state of these actors is reviewed.

3.3 Government

3.3.1 UK Flood risk management: the regulatory framework

Knowing the stakeholders and understanding their needs and roles in the context of flood risk assessment is essential when selecting effective risk information (United Nations, 2012; DEFRA and EA, 2007). This section presents a brief review of the key regulatory frameworks that form the modern FRM in the UK, with the focus on understanding the key legislation that changed the scale and responsibility of risk management for better supporting of properties at risk. Since the beginning of 2000, the modern FRM (as discussed in section 2.3) started to become embedded in the UK national policies. This change affected the role of the central government from the prime responsible body for managing risk to be one of the many stakeholders, (DEFRA and EA, 2006b; Davies, 2002; Penning-Rowsell and Johnson, 2015). The following regulations marked the key turning points of this shift and form the present state of government roles and responsibility with regards to communities at risk.

3.3.1.1 EU Water Framework Directive 2000 and UK Making Space for Water 2005

The current general flood management law in the UK is a transposition of the two European Union (EU) directives: Water Framework Directive 2000, and Flood Directive 2007. Water Framework Directive 2000. was designed to improve and integrate the water management bodies across the EU, requiring all members to manage the water environment to consistent standards. The UK endorsed this act in the Water Environment Regulation in 2003, entitling the Environment Agency (EA) as the coordinating authority for implementing the requirements of this directive.

This was followed by Making Space for Water (MSFW) 2005 which set out the UK government's new strategy in flood and coastal erosion risk management at the national level. It instigated a change to a holistic risk approach to integrating national and local approaches to reduce the flood risk, and embedding flood and coastal risk management in government policies. The key messages of this strategy was to (i) promote adaptation of flood resistance and resilience measures in both new and existing buildings with financial incentives; (ii) improving the provision, availability and sharing of flood risk information and (iii) advice on flood resistance and resilience to residents by trained builders and surveyors. This strategy also highlighted the need for homeowners to shoulder responsibility and install appropriate measures (Beddoes and Booth, 2011).

3.3.1.2 EU Flood Directive 2007 and UK Flood Risk Regulations 2009

The second European directive that had a direct influence on UK flood risk management system, was the Flood Directive 2007, a sister directive to the Water Framework Directives. It is considered to be the first EU directive dealing especially with floods (Mostert and Junier, 2009). It places a duty on EU members to prepare for flood hazard and develop flood maps and flood risk management plans for their countries. It required collective actions of both government and public authorities and effective communication to reach harmonious risk management across different players (Sayers et al., 2013). In 2009 the UK introduced the Flood Risk Regulations to England and Wales to act as a statutory instrument that transposes EU Flood Directive 2007. These regulations place a new duty upon the EA and other Lead Local Flood Authorities (LLFAs) to cooperate with one another and take responsibility for managing flood risk at various scales as well as property and community level. Flood Risk Regulations require the EA to conduct assessments, mapping and planning to ease flood risk from main rivers, the sea and large reservoirs. LLFAs are accountable for other sources of flooding. Regulations require the EA to publish the outputs. The outputs of the Flood Risk Regulations require the aforementioned authorities to look at *'the potential adverse consequences of future floods for human health, the environment, cultural heritage and economic activity*' and, in combination with Flood and Water Management Act 2010 (see section 3.2.3), provide encouragement for greater levels of data quality and data sharing (including the property level information).

3.3.1.3 Flood and Water Management Act 2010

Complemented by Flood Risk Regulations 2009, Flood and Water Management Act (FWMA) 2010 posed some changes to the assessment and management of flood in the country. It gave the upper tier local authorities in England important new powers and responsibilities in managing flood risk including creating the Lead Local Flood Authorities (LLFA). It also addressed 16 of the Pitt Review recommendations on placing a duty on associated organisations to co-operate share information and clarified responsible bodies, in

particular, granting bigger role in managing the flood risk in their territories. The Act introduces the '*duty to cooperate*' requiring all the risk management authorities to work together across administrative boundaries. Thus, any approach to FRM should allow flexibility and support joint working with other authorities. FWMA 2010 introduces the Local Flood Risk Management Strategy. It puts a new responsibility on LLFA in England to investigate flood incidents (Section 19), and develop, maintain and monitor their flood risk locally (Section 9).

This regulatory framework determines the Government as one of the key FRM stakeholder groups. The following section reviews the key government organisations responsible for FRM and the level of flood risk data they generate and use.

3.3.2 Department for Environment, Food and Rural Affairs

The Department for Environment, Food and Rural Affairs (DEFRA) have the overall responsibility for FRM policies. They also provide funding for relevant activities through grants to the EA and local authorities. DEFRA has endorsed the EU 2007 Directive into 2010 FWMA2010 and passed the strategic and operational responsibilities of managing and overviewing the management of all sources of flooding and coastal erosion to the EA.

3.3.3 Environment Agency

The Environment Agency (EA) is an executive non-departmental government body responsible for producing and monitoring the national flood and coastal erosion risk management strategies in England. It issues warning and guidance for flood events and sets out how the public body works with individuals, communities and organisations to reduce the risk of flood. The Agency produces national flood maps. These maps were initially developed to assist local authorities and planners to understand how new development proposals can affect or be affected by flood (Porter and Demeritt, 2012). The first such map, Indicative Flood Map, was published in 1999. It was binary where areas were divided into either being at risk or not. Since then, the EA has developed a series of national flood forecasting models, risk maps, and databases to support flood risk management strategies and decision making. The EA flood maps can be categorised into three broad groups:

1. **The Flood Map for Planning:** these maps illustrate the natural floodplains and the location and severity of floods if no flood defence structures were in place. The map uses the same risk categories as local authorities; therefore, the data contributes to the local planning and local decisions in three layers of Flood Zone 1, 2 and 3. The information on these maps is available for the use of the public via a postcode search. These flood maps show outlines for the area at risk, however, the distribution of the risk within that outline is not provided, therefore not suitable for use in estimating risk at the property-level basis.
2. **National Flood Risk Assessment (NaFRA) and Risk of Flooding from River and Sea map (RoFRS):** These maps illustrate the risk of flooding considering the impact of flood defence structures and other mitigation measures in place. Results show the annual chance of flooding in three categories of low, moderate and significant (knowyourfloodrisk.co.uk, 2015). Information on these maps is intended for the use of flood risk management policy makers, identifying investment priorities and helping the insurers in setting risk-based premiums and excesses.

(a) Risk of Flooding from Rivers and Sea – Properties in Areas at Risk: this database aggregates the Risk of Flooding from Rivers and Sea data with Ordnance Survey data and estimates the flood likelihood categories to properties simply based on the likelihood of flooding to the area the property is within. It uses four categories of return period: very low with the chance of less than 1:1000, low with the chance between 1:100 and 1:1000, medium with the likelihood of 1:30 and 1:100 and any area with the probability of 1:30 or more will be into the high-risk category. The EA's flood frequency maps are updated every three months.

(b) Risk of Flooding from Rivers and Sea – Postcodes in Areas at Risk: A database that uses the Risk of Flooding from Rivers and Sea product with Ordnance Survey data and Royal Mail data to display the number of properties in each postcode area in each of the four flood risk categories.

3. **Risk of Flooding from Surface Water map:** this map shows the risk of flooding from surface water from the impact of heavy rainfall including the depth and velocity in four risk categories of high, medium, low and very low. At the moment there is no warning service for surface water flooding. This information will help the local authorities to manage the risk. Similar to other EA information, this map is not property specific and therefore not suitable for assessing the risk to individual houses (DEFRA and EA, 2014a).

Over the years there have been several improvements in presenting the Agency's flood maps. For example, since 2011 the likelihood categories of flood became more clear and consistent across most of the EA maps. Most of the flood risk maps also became available to the public. However, the information presented in these data is a presentation of 'hazard' information i.e. the characteristics of the flood, rather than 'risk' to a particular receptor as they do not comprise information regarding the vulnerability. Therefore, based on the definition of 'risk' as a combination of 'hazard' and 'vulnerability' discussed in section 2.4, these maps are flood hazard maps rather than flood risk maps. Additionally, these maps only illustrate the outline of an area at risk rather than the distribution of risk within that outline. As the EA signifies, data on their flood maps are indicative and not suitable to ascertain hazard at micro scale such as the property level. Consequently, whilst at the property level, this information can be adopted as a suggestion of the existence of the hazard, they cannot ascertain the existence or the level of risk to individual properties.

In addition to the EA maps, there has been significant growth in the number of commercial organisations developing detailed flood models and maps, based on the EA databases. They produce detailed flood models that cover pluvial and coastal flood risk for the UK. However commercial flood data are not available for public use and are usually used by the insurers and the commercial sectors, in addition to the EA information rather than a substitute for it. Examples of micro-scale flood risk data include commercial databases such as JBA Flood Map and Ambiental Floodscore database.

3.3.4 Lead Local Flood Authorities

At the local level, two groups of authorities are involved in flood risk management. The first groups are planning authorities. Under the National Planning Policy Framework and associated guidance, the local planning authorities are responsible for determining planning applications for development in areas at risk of flooding. The second groups are and Lead Local Flood Authorities (LLFA). The Flood Risk Regulations (2009) describes LLFAs as the country councils, district council or unitary authorities. They have the duty of

revising the primary flood maps and risk management produced by the EA and produce flood maps and management plans across their administrative areas. They are also the government body responsible for gathering data during and after flood events including the properties affected. These duties are also restated in FWMA Sections 2.2 and 2.3.

Examples of local authorities using property level flood risk data can be found in the allocation of resources to flooded properties via central funding schemes. For instance, the DEFRA Property Level Protection Grant scheme (2009-2011) provided funding to the local authorities to be delivered to households, helping individual properties to invest in protective measures where other traditional flood management solutions were not available. It targeted residential properties and homeowners, provided those with flood risk surveys that identified the main points where water can enter their property and then highlighted suitable flood protection measures that could be installed. Another example is the Flood and Coastal Resilience Partnership Funding 2011, in which property-level protection was also included. The eligibility for funding was calculated through the Flood Defence Grant-in-Aid system which is based largely on the number of households affected (DEFRA, 2011b). This funding was in line with the Government strategy to help to bring local communities together to engage and better manage their flood risk. DEFRA (2010) reported that the datasets collected at the local level by flood authorities tend to be specific to large flood events: geographically constrained or collected in different formats and levels of detail. There have been several attempts from the county councils and district councils to address this issue. For instance, the SWIM Project developed by the Dorset County Council in collaboration with the EA introduced a web-based system for recording data related to flooded properties. The aim of this system is to help multiple agencies in managing risk in their combined response to flooding and better prioritising their resources both during and after the flood event (swim.geowessex.com, no date). The initial consultation with representatives from local authorities (see section 4.3.1) noted that SWIM has only been adopted by a few flood authorities in the UK. A similar initiative was introduced by district councils in Gloucestershire. However, only some of these district councils adopted the system and the County Council uses a different system.

Other examples of data sets available to the local authorities include National Receptor Dataset (AfA171). This database is a collection of risk receptors primarily intended for use in flood and coastal erosion risk management and includes property points with information on property type such as floor area. This dataset is available for government bodies but not the public (Data.gov.uk, 2017).

During the emergency of a flood event, LLFAs are responsible for supporting the community and the individuals. Consultations with some local authorities suggest that often, they rely on several sources of data such as the live witnesses, phone calls, and onsite observation, that are not consistent and are limited to data that are reported to them. LLFAs also rely on their own knowledge of the local area and individual house, based on the previous flood events to detect the most vulnerable homes. Only a limited proportion of data gathered is recorded, with the rest remain as individual knowledge of the responsible LLFA officer. There is always a risk of losing these data when a new officer picks up the responsibility.

Although there has been a great improvement in the quality and variety of maps produced by the EA, there are still several shortcomings in the type of data provided and how these data are represented. These maps

and datasets include a different essential layer of information for the purpose of a broad scale view of risk and are appropriate for estimating whether a local area is at risk of flooding. This means that, as specified in the EA website (EA, 2018b) they are not suitable for identifying individual properties at risk of flooding.

3.4 Property owner

Property owners and residents play an important role in managing risk to their property (Government Office for Science, 2004). Based on the common law (as cited in environmentlaw.org.uk; in houselawyer.co.uk), the landowners have the right (power) to protect their properties from flooding and erosion (gov.uk, 2018; Devon County Council, 2017). Whilst the government bodies have a major role in providing flood defences, it is the property owners' responsibility to protect their homes from any kind of hazard including from flooding (Priestley, 2017). Property owners and developers are also required to consider the Flood Risk Assessment (FRA) report as a part of their planning application if the site is located in a Flood Zone (EA Flood Map) to demonstrate that proposals will not increase flooding elsewhere (DEFRA and EA, 2014b). They are increasingly being seen by policymakers as needing to take personal responsibility to protect their properties against flood risk (Sanders and Phillipson, 2003; Pitt, 2008). Thus, it seems crucial for them to be aware of the probability and severity of flood risk in their area, and have knowledge of their building specification and measures they could take to protect their home.

Households need to have access to information about the risk, its effect on the house and the mitigation options available to them. This information can assist households to determine the best value-for-money options in protecting their properties (Oakley, 2018). For the property owner typically, the economic loss includes the cost of physical repair/replacement, clean-up (e.g. paying for the house to be dried out), the costs of living in temporary accommodation, and possibly the costs of re-selling the house with a flood history (EA, 2005b). In addition to that, as the chance of flood risk increases, it may be increasingly difficult for the owner to obtain insurance for the house (Huber, 2004; ABI, 2012). Although this issue is intended to be temporary and partially addressed by Flood Re, there are concerns about the long-term situation of insurance for such houses (Surminski 2016).

There are a few resources available in the public domain which property owners have access to understanding the extent of flood risk and the possible damage to their house. Examples include the EA online flood maps and detail on flood risk in the area from the LLFAs (not all the LLFAs have the record of such data). Other sources are obtainable through Freedom of information is available including previous flood experience in the same house (if any), and their insurance company. Some members of the Royal Institute of Chartered Surveyors can produce a flood risk report/survey for the property to identify the types of measures most appropriate to improve its resilience. However, the result of the survey is highly influenced by the surveyor or loss adjuster's knowledge of factors influencing the level of risk (Kenney et al., 2006) which sometimes can lead to different recommendations for different mitigation methods for the same affected property.

3.5 Insurance industry

Flood insurance is seen as a key element of FRM in the UK (Lamond, Proverbs and Hammond, 2009; DEFRA, 2011b; Krieger and Demeritt, 2015). Although insurers do not have a pre-determined regulatory

role similar to the government's, they directly influence the UK FRM policies and have been one of the bases of UK flood risk management for almost a century (Penning-Rowsell, Priesta and Johnson, 2014; Huber, 2004). Additionally, they have been recognised as one of the major PLFRD producers and users (DEFRA 2010; DEFRA 2011). Insurance is widely recognised as a tool for increasing financial resilience to severe weather events such as floods. It performs a risk transfer role and offers a cost-effective approach to managing the financial consequences of flooding (Surminski and Oramas-Dorta 2013; Penning-Rowsell, Priesta and Johnson, 2014). This makes the insurance industry one of the most vulnerable sections of the industry to the consequences of increasing flood risk to people and properties. The repeated loss on flood claims illustrates that effect. For example, the 2000 flood was one of the major flood events affected more than 10,000 properties which cost the insurance industry £1 billion (Cowley, Ley and Whitlow, 2002). The 2007 flood damage to domestic properties was at a total value of £1.72 billion (EA, 2010b). In 2012 widespread flooding affected more than 8,000 properties, causing £400 million worth of damage (ABI, 2014b). In 2013-2014 the number of claims on flooding was 18,700 and the industry paid around £30,000 for each flooded home (ABI, 2015).

Flood insurance potentially has four roles (Botzen and Van Den Bergh, 2008; Lamond, Proverbs and Hammond, 2009; Sayers et al., 2013; Surminski and Oramas-Dorta, 2013):

- **Reimbursing and compensating** those who suffer damage. Insurers act as the main source of funding for the reinstatement of flooded residential properties by restoring them to their pre-flood condition. This reduces the need of government to aid investment in post-event recovery.
- **Spreading the economic costs** of flooding across communities and policyholders. Through premiums setting systems, the potential costs of flood damage are spread over many years in relatively small payments rather than having a single large cost if and when a flood actually occurs.
- **Providing risk management** advice and lobbying for political and regulatory responses. In private insurance systems such as the UK's, there are agreements between Government and the insurers which bound the state to provide sufficient flood protection.
- **Incentivising a change and modifying of the behaviour** of the policyholders by promoting damage mitigation, and rewarding the 'good behaviour' such as joining automated warning schemes and adopting damage-reducing measures.

The application of these roles in the UK has its own characteristic in the context of flooding. The insurance industry is not only one of the major owners and users of property flood risk information in the UK but its market is the largest in Europe and the third in the world. Currently, the common approaches are that the UK flood risk insurance performs the three first roles out of the four addressed above. Apart from their ability to provide pay-out, they have other functions following a major event such as damage assessment, monitoring the scale of the event and collect statistical information and provide the authorities with advice (ABI, no date). In the UK, flood insurance is part of building and contents insurance. It is compulsory for the property owners to purchase 'full insurance coverage' in order to be recognised as qualified for a mortgage (Huber, 2004). The role of household insurance England and is based on the relationship between the insurer and government which is relatively complex due to their unique history.

3.5.1 Statement of Principle: an agreement between insurers and government

Beginning with the 'Gentleman's Agreement' in 1960, the government and the insurers began a series of agreements to make flood insurance more available for houses and small businesses. Following the enormous loses instigated due to 1990 and 2000 floods, the insurance industry issued the first of Statement of Principle (SoP) agreement which allowed the industry to monitor government expenditure in allocating financial support for flood defences. These requirements were reflected in Planning Policy Statement 25 (PPS25), and later the National Planning Policy Framework 2012 (Penning-Rowsell, Priesta and Johnson, 2014). Flood Re is the latest agreement between the government and the insurance industry.

This concise review set the background knowledge to understand the structure and the key responsibilities at the property level over the last decades in the UK. The beginning of the 21st century saw radical changes in the UK FRM system. These changes manifested in the shift from 'government' to 'governance' in the FRM context. This coincided with alteration from top-down decision making towards a more diverse and inclusive process of governance (Davies, 2002; Jordan et al., 2003), and the requirement for various stakeholders to be involved in steering decisions and practice. Based on this regulatory framework, in the following sections, the key stakeholder groups responsible for PLFRM and the use and accessibility of property level data are established.

3.5.2 Previous agreements

The design of flood insurance in the UK is a partnership between the private sector and government, which follows a market-led flood insurance scheme with its operation dependent on government flood defence provision (Lin, De Guzman and Cuevas, 2007). In the late 1950s and early 1960s following a series of destructive floods, the UK Government attempted to make the flood insurance widely available. In 1961 'Gentleman's Agreement' was made between the government and the insurers to make flood insurance more available for houses and small businesses. Based on that agreement, regardless of the risk, every household would be offered flood insurance at an additional premium of less than one pound. In return, as a part of general household insurance, every property was charged irrespective of the extent of the risk (Sayers et al., 2013). But the cover was only available on 'request' and because of lack of awareness of its availability, there was no significant market penetration following the agreement. It was not until 1970 that the Building Societies Association made flood insurance mandatory for all their mortgages holders (Penning-Rowsell, Priesta and Johnson, 2014) and consequently, by the beginning of the 80s most of the households had the cover in place.

In the 1990s, the improvements in data collection methods and flood risk mapping and modelling gradually enabled the insurers to narrow down the areas at risk with greater precision. These new tools enhanced insurers' ability to detect areas of greater flood risk and opened up the opportunity for them to be selective on the price of the risk accordingly (Huber, 2004). After the flood events of 1990 and 2000, the insurance industry estimated that a major flood event can cost the industry as much as between £1 billion and £2 billion. This required immediate action to protect the industry (Sayers *et al*., 2013). Since then, a number of agreements were made between the state and the Association of British Insurers (ABI), which as leading trade association for insurers in the UK, stands for almost 300 member companies who altogether put 90% of

the UK insurance products into market to secure the future of flood risk insurance in the country (ABI, 2014a).

In 2000, the Assassination of British Insurers (ABI) published a Memorandum of Understanding to the government in which for at least two more years they agreed to continue to maintain coverage under the general policy of the ABI members for the properties which already had cover. To be able to continue offering flood insurance to every property and while avoiding unbearable financial loss, ABI began to put the government under pressure to take further responsibility in flood risk management and allocate sufficient funds to improve flood defences (Sayers et al., 2013). This was the beginning of the government taking a new approach towards flood management through the implementation of Planning Policy Statement 25 and allocating financial support for flood defences. Eventually, these changes reflected in 2002 'Statement of Principles on Prevision of Flood Insurance' (SoP) where the industry renewed their basic agreement with the government in which ABI members consented to make flood insurance available, not to all, but only to the houses and small businesses that were at flood risk of less than 1.3% (once in every 75 years). According to Penning-Rowsell, Priest and Johnson (2014), these criteria not only immediately excluded a considerable proportion of properties at risk, but also enabled the industry to be more selective and avoid major loss of money. The government maintains the role of flood management and providing flood risk information (ABI, 2008).

In 2008, SoP was renewed but the only major change was excluding properties built after 2009 from the cover list (DEFRA, 2013b). Concerns regarding whether and how flood insurance continues to be widely available began when the industry insisted that unless there is a new arrangement, they would not renew their commitment for 2013 and after (Penning-Rowsell, Priest and Johnson, 2014). This was mainly due to the fact that, from the industry point of view, the statement was just a 'short fix' or a 'sticking plaster' and never was considered a long-term solution (ABI, 2013). The SoP agreement officially ended on 30 June 2013 but extended a further month to give more time for a new approach to be agreed upon (DEFRA, 2013b). Up until this point, the relationship between the government and the insurance industry could be explained as an agreement in which the government provided flood defences and monitored the new developments in flood risk zones. In return, the industry, except in some unavoidable circumstances, provided flood insurance for all the UK households. Hence, forming the UK's flood insurance model based on the private market and slight direct government intervention (Penning-Rowsell, Priesta and Johnson, 2014).

Prior to the SoP expiring, in 2010, three working groups comprising DEFRA, the EA, HM Treasury, Department of Communities and Local Government (DCLG) were organised to '*consider potential responses to developments in the insurance market and the ending of the Statement of Principles*' and ' *managing the financial risks of flooding after 2013*' (Haigh and Crabb, 2013, p.14). To do so, one of the working groups tested strategic options against their agreed common principles. Eventually, in June 2013 ABI and the UK government agreed on a Memorandum of Understanding (MoU) on how to continue safeguarding UK flood insurance through the Flood Re scheme (DEFRA, 2013a).

3.5.3 Flood Re: the current and future approach

Flood Re is the most recent agreement between the UK government and the insurance industry to manage the flood loss at the property level. The main idea behind Flood Re, as described through Water Bill 2013, is to set up a reinsurance fund managed by the insurance industry for high flood risk areas. This is to help individual insurance companies to afford the big claims and to deal with the 'independent' nature of flood insurance. Flood Re is an organisation owned by the UK insurance industry, to which fixed premium insurers can pass on the flood risk part of home insurance policies. It is funded by a combination of premiums to reinsure the flood risk and a statutory levy on all UK household insurers, calculated in proportion to their share of the market. This means that not all insurers will offer Flood Re, but those that do it can pass the flood risk element of the insurance to Flood Re for a set reinsurance premium. It is a temporary measure planned to start in 2016 and last until 2039. Households under low or normal risk will still be provided with insurance as standard, whilst the flood element of the home insurance policy for the residential properties at higher risk can be passed to Flood Re by insurers.

There are, however, several concerns with the Flood Re scheme. One of the key criticisms is that, similar to the previous agreement, Flood Re does not provide builders and property owners with enough knowledge or power to play a role or have a say in managing their risk or upgrade their flood insurance status (Hussain, 2014). Similarly, Surminski (2016) argues that Flood Re essentially suggests a different solution to distribute flood costs without establishing a link between the mitigation measures and of affordable flood insurance. Even though measures of resilience or resistance are considered in the scheme there is still no guarantee that affordable insurance (or reduction in current premiums) will happen. Another main concern about Flood Re, similar to the previous agreements, is the exclusion of new buildings. The DCLG (2007) and NFF (2014) expressed concerns about the future of new buildings and sustainability and insurability of new developments facing flood. Although it can be argued that it is done to disincentivise the new developments in flood-prone areas, previous studies (such as Surminski and Eldridge, 2014) suggest that there is, in fact, limited evidence whether this 'disincentive' has worked in the last decade, as development in significant high-risk areas increased despite the exclusion.

3.5.4 Insurers and data

Insurers are interested in flood risk data to map their business, setting premiums and giving a competitive compatible quotes whilst protecting their business from facing major losses. Although there is no consistent approach in the business on the level of data detail they use to predict the risk, in a general view, it can be said that they tend to use more detailed data in comparison to the government (DEFRA, 2010). The insurance industry relies on a variety of sources of data to gain a picture of flood for the purpose of risk selection and pricing. Individual insurers approach flood risk, and consequently, the data they use is distinctly influenced by an insurer's strategic approach and risk appetite (DEFRA 2011). Better information enables the insurers to make a more informed and accurate assessment of the flood risk and to avoid adverse selection of risk. Adverse selection occurs when premiums do not reflect the actual risk. and lead to the insurers' loss by owing to the payment of more claims compared to the receipt of premiums (Botzen and Van Den Bergh, 2008). Following the expiration of the SoP and the establishment of the Flood Re agreement, the industry is

now officially moving towards risk-based premiums. This further highlights the significance of data for this stakeholder group.

There are two key types of data sources used to calculate insurance premiums across a risk portfolio: flood risk models and claim information. As mentioned in 3.3.3, the EA flood maps and flood risk is one of the insurer's key sources of flood data. It is also common for insurers to purchase data from commercial providers which are more detailed than the data available from the EA. Some insurers such as Aviva had developed their flood risk models combining commercial data sources such as that of JBA's with their data on claims (Aviva, 2004b). There is no common rule or principles on how to claim data is recorded across the industry. Examples of recorded data are address and type of flooded dwelling, flood depth and duration, wall and floor construction method as well as the reinstatement costs (Soetanto and Proverbs, 2004; Joseph, 2014). Much of industry data is confidential and is only available internally within the individual organisations concerned.

3.6 Chapter summary and the gap in knowledge

In this chapter, through review of flood risk management in the UK, the key stakeholder groups that are directly involved in managing flood risk at the level of domestic properties were identified as Government, insurers and property owners. These groups' engagement in FRM at the property level and their data use requirements were reviewed. It was discussed that the responsibility for FRM decision making and delivery in the UK is dispersed amongst government agencies (including local authorities) and individuals (DEFRA and EA, 2006b). The distribution of risk management responsibility, through decentralisation of the government, localism and the EU flood Directives, called for the participation of local authorities and individuals. Further to that, changes in the role of insurers since 2000 have altered the balance of FRM power and responsibility to a public/private/citizen stakeholder combination (ABI, 2004; Green and Penning-Rowsell, 2004; Huber, 2004). Figure 3-1 summarises the key legislation and agreements initiating these changes as discussed in this chapter.

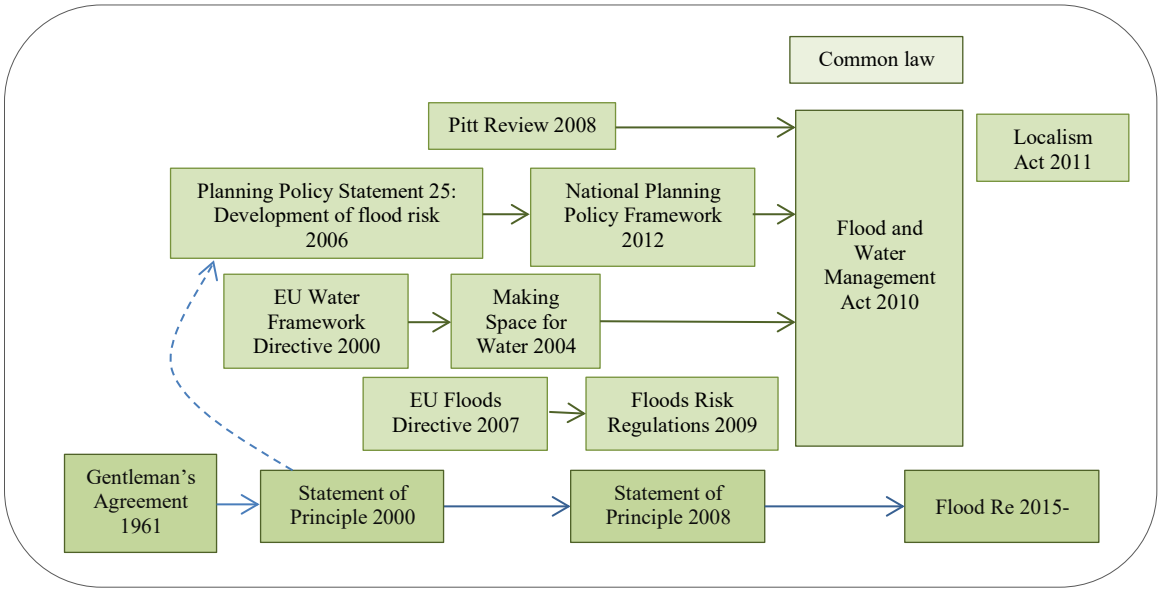

Figure 3-1 Key legislation and agreements affecting the current FRM

Through the extensive review of FRM literature in Chapters 2 and 3, it has been discussed that despite the apparent benefits of the property level flood risk information, the use of such data within the relevant stakeholder groups is not established. Whilst these stakeholders can determine whether individual properties are at risk as a consequence of their physical location within flood risk maps, it is not common to establish property level factors that might reduce or increase risk. The reasons for this discrepancy represent a significant gap in knowledge.

It was further discussed in this chapter that given the significant role and responsibility of government, insurers and individuals in managing flood risk, to investigate the case for PLFRD it is necessary to obtain a collective view of these stakeholders groups. Additionally, due to the specific characteristics of each group, it is important that the view of each group is secured. Due to the inadequacy of evidence in the literature, obtaining 'first-order observers' seems to be necessary to progress the research and investigate the gap. Hence as a part of this research, in the next chapter, a suitable methodology is developed to investigate advantages and barriers to the use of property level data in managing flood risk for domestic properties in the UK. The next chapter will provide details of the methodology and explains different steps for achieving its discussed aim.

Chapter 4: Development of the theoretical framework

4.1 Introduction

The previous two chapters have explored the definition of flood risk, components of FRM, and their relationships. This was followed by identifying how this risk is managed in England at the property level, with the focus on the stakeholders' roles and responsibilities and the current state of data use amongst them. It was suggested that following the changes in the scale and mode of the risk mitigation from government to governance, with the focus on more localised and risk-based strategies, there exists a discrepancy between the recommendations (reviewed in Chapter 2) for better use and availability of data at micro level amongst the key stakeholder groups. This research takes this gap to analyse not only the reasons behind the lack of implementation evidence with regards to these recommendations but also use it as an opportunity for a broader investigation of the characteristics of the flood risk governance setting at the scale of property.

To provide the conceptual setting for the study, this chapter starts with discussing the concepts and theories that contribute to the evolution of scalar arrangements with regards to flood risk management. At this stage, the focus is on the key concepts that are used to identify the processes involved in justify a particular scale of risk management notably at the property level scale.

Next, it examines the theoretical discussion on risk governance and scalar arrangements and discusses the rationale and theoretical explanations behind governance settings that lead to the current state of flood risk governance in England. This helps to identify necessary characteristics of Flood Risk Governance (FRG), through which Flood Risk Management (FRM) is delivered. The application and relevance of knowledge governance as a proxy to connect these two areas of knowledge, in the context of this research is then discussed and the key concepts used to identify the factors involved at the scale of property FRM in England are studied. This process can be summarised in the figure 4-1:

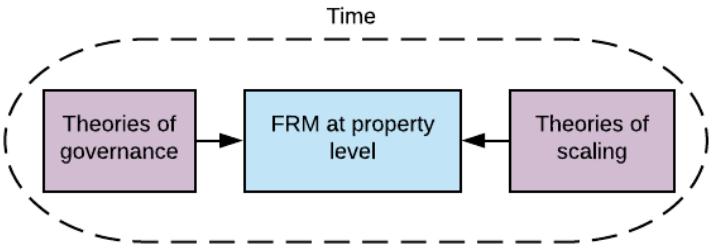

Figure 4-1 Summary of the main theories

Finally, this chapter will conclude a conceptual framework to gain a better understanding of scale and its relevance to theories of governance and the influence of scale and scalar policies in the evolution of discourse, power, rules and relationships of key stakeholders.

4.2 Re-Scaling of flood risk management in England

Re-scaling flood risk management is a key factor of modern FRM in England. Scale is often perceived as a complex concept and used to study the interactions between different social, political, spatial, material, and temporal dimensions. Analysing the concept of rescaling provides a framework to study the process of localism in FRM and associated debates regarding the rearrangement of power and rules amongst the actors (Wissen, 2009). This comprises analysing levels that capture the process of governance, and the associated effects on the nature and scale of solutions to flooding issues. In this section, the rationale for scalar reconstructions and the power relations involved in England FRM is reviewed with the focus on the change in the political and social context that affected FRM at the scale of an individual property. Due to the focus of this study on a specific scale of risk management, understanding the rationale for this change can assist with explaining and unravelling the motives and arrangement of actors at this scale.

Scale is perceived as an absolute (fixed) term and also a relational (dynamic) concept, affected by the political discourse, conflicts and negotiation (Marston, Jones III and Woodward, 2005; Thiel, 2010). In its absolute form, it can be quantified into aspect such as temporal and spatial e.g. administration, hydrology, ecosystem and economy (Dore and Lebel, 2010). However, this concept appeared insufficient in explaining the complex arrangement of relationships, networks and variety of players. Therefore, the relative scale was suggested as the conversion of an absolute scale to a functional connection of a component or process to another. Scale and the level at which the governance process occurs, have a corresponding effect on the type of solution to environmental problems (Alexander, Priest and Mees, 2016). Therefore, a core aspect of the scalar arrangement is its evolution due to the continuous modifications in the social structure and relationship between private and public stakeholders (Fainstein, 1999). This leads to scale moving away from ontological characteristics to an exceedingly politicised concept that is created socially over political struggle, the result of strategies of political players (Swyngedouw, 2002). This gives the scale wider scope to comprise socio-spatial relationships (Jessop, 2007) focusing on understanding spaces of engagement, the capacity to act and changes in the social interactions (Mees, Driessen and Runhaar, 2014) to ensure the consideration of stakeholder's needs and interests (Cox, 2013).

Scale literature that oriented around risk management approach focus on investigating the administrative scale that is responsible for dealing with a certain hazard (Zevenbergen et al., 2008; Brown et al., 2012), the appropriate scale a certain hazard should be assessed (Garrick and Hall, 2014), or in the context of non-special scales, understanding hierarchy in which risk can be organised (Gardoni and Murphy, 2014). However, regardless of their focuses, they all seek to identify the existing scales and match the risk with the actors on a suitable scale of assessment and decision making (Garrick and Hall, 2014).

4.2.1 The politics of scale

As discussed in the last section, scale is a concept that is socially created and subject to political struggle (Swyngedouw, 2004; Cox, 2013). With the focus on flood risk management, this section uses the term ‘politics of scale’ as suggested by Penning-Rowsell and Johnson (2015) to study the scalar dimension views in political processes arguments. The literature of the politics of scale assists with an examination of the meaning of scale and the conceptualisation of the FRM structure and understanding the social coalitions,

political processes and power dynamics that have affected this scale. However, instead of studying scale through scalar politics, Penning-Rowsell and Johnson (2015) suggest reframing it as politics of scale. This reframes scale as epistemology to represent practice and actors who practice them, rather than scale as an actor itself, through attributing performativity (Keisar and Nikiforova, 2008) and representational practice to it (Jones, 1998), shifting the analytical focus away from scale discourse.

A significant proportion of scale literature was undertaken by geographers with political economy tradition ideologies. The political economy of scale comprises various practices of scales and their effect and consequences for regulation practices and social struggles (Swyngedouw, 2002). On its early form, political economy was highly influenced by Marx's Capitalism idea and the emphasis he put on labour as value (Robbins, 2011). Therefore, with its capital-labour relations lens, the traditional political economy tends to view sociocultural relations as supplements to capitalist production. Whilst it was successful in providing human geography studies with an understanding of scale as a socially constructed concept (Kaiser and Nikiforova, 2008), it was limited in explaining some aspect of environmental change. It was argued to be limited in recognising the shift in the global economy following the globalisation and exploring the policies of scale as a part of this shift. It viewed globalisation as a transformation in the global structure rather than a govern-mentality where there is a semantic link between governing and modes of thoughts (Lemke, 2002). This view failed to consider scale as a discursive practice which contributes to the design of the relations between power, place and identity (Sidorov, 2000). In response to these limitations, political ecology arises to better explain, for example, the environmental changes and scale, and studying political actions at community and regional levels (Stott and Sullivan, 2000). It moves away from the pure political economy view and combines the ecologically rooted social science with the principle of political economy.

In order to understand scale and its ties to social constructions in politics of scale, Brown and Purcell (2005) suggest that the theoretical principle of scale derives from three core beliefs including; it is a relational concept, it is socially structured, and therefore can be both fixed and fluid. It is a fixed arrangement in terms of the existence of pre-defined social structures and distribution of power, notably in the inserted qualities such as the dominant position of privileged class groups in the policy process (fix). However, this view undermines the performativity of scale and its effect on the actors that engage in `scale talk' and `scale politics'. For instance, Kaiser and Nikiforova (2008) argue against isolating the definition of scale as an end product of social construction. Instead, they introduce the inclusion of historically contextualised relationships between hierarchies and discourses of scale which defines scale (fluidity). The policy of scale and scalar relationships are socially produced to address political struggle. Since political struggles are ongoing processes and influenced by social intention at geographical spheres, scale and scalar arrangement tend to become fluid and constantly being made and remade (fixing, unfixing and re-fixing) (Brenner, 2004; Brown and Purcell, 2005). From a different point of view, scale is seen as a social tool rather than socially produced. Kaiser and Nikiforova (2008) suggest that scale is defined by various institutional scaling. Consequently, scale and scalar hierarchies are not social contractions but rather social means of discourse to create a scalar effect (Kaiser and Nikiforova, 2008). The ongoing changes in social structure between different stakeholders and actors make the study of the dynamic nature of scalar arrangement evolution challenging (Brenner, 1997).

Scale is also a fundamentally relational concept as each scale reflects a set of relationships it has with other scales, where they are tied up together (Wissen, 2009). For instance, the national scale is rooted in the global scale, and the global scale includes multiple national scales. In that regards, Brenner (2001) divides the studies on the scale into singular and plural connotations. He discusses that singular connotation studies that focus on a single scale and not the relationship among the scales, do not talk about scale per se. Instead, what is discussed is a specific place, territory, or space. On the contrary, studies that focus on changes in administrative, strategic, discursive, and interactions between scales, i.e. plural connotation approach, are truly capturing the notion of scale. For instance, a national scale cannot be examined in isolation but must be analysed in relation to other scales. Therefore, analysis of scale requires an understanding of both how it is produced through social constructions and how the relationships between scales are created. This perspective asks for investigating the agendas and potential benefits of actors who advocate a specific scalar arrangement, and recognising that scales are inextricably tied together over time. Based on this view, in the politics of scale, scale is studied with regards to the processes of the social structures and the changing role of statehood (Brown and Purcell 2005). Hence, any major change in scalar arrangements can lead to a change of the relationship and interaction between actors (Neal, 2013), requiring careful studying of these changes in the new policy settings (Pugalis and Townsend, 2013).

These complex interconnections of human-environmental issues continue to complicate and challenge current water governance systems (Norman, Bakker and Cook, 2012) calling for scalar perspective for understanding the complex dynamics that exist between nature and society (Kaiser and Nikiforova, 2008; Harris and Alatout, 2010). The next section presents views on how scale in flood management in England has changed through understanding theories behind the power dynamics, organisations, institutions and social networks which instigated these rescaling processes.

4.2.2 Conceptualise the scale of FRM in England

The current scalar arrangement of FRM has a deep connection into its early arrangements during the early 20th century. By the introduction of the Land Drainage Act 1930 and making the grant-aided central government investment more available to local authorities, the first attempt was made towards creating a code of law associating with what is known today as FRM (Evevrs et al., 2016). The resource at the catchment scale was further increased through the formation of the Catchment Board in 1930 and the introduced Regional Development Funding Corporation taxing method for areas at risk. Penning-Rowsell and Johnson (2015) suggest these attempts to be a strong display of the concept of scalar unifications to take control through controlling the resources. River Boards Act 1948 took over the responsibility for managing river flood. The board were excessively oriented towards a local issue which did not always linked to national imperative. To increase the control over that, a national contribution to FRM cost through Regional Development Funding Corporation taxes was suggested instead of limiting this contribution to those benefiting directly. In 1965 River Authorities replace the River Boards. The scalar arrangements at this stage continued to be a diverse arrangement of local/regional/national governance (Smith and Tobin, 1979).

The regional scalar arrangement was introduced following the Water Act 1973. The Water Authorities were introduced as a supplement to existing River Authorities establishing new regional authority with full management of the whole water cycle. A main criticism was towards the fragmentation of water authorities

and as a solution reducing the number of water authorities was suggested. From a scalar politics viewpoint, this step was a move toward decentralised power through the further union. These regional catchment based authorities were, later on, privatised by the Thatcher government and took control over activities such as sewage disposal.

Water Act 1989 was introduced as the first national organisation with responsibilities for managing flood risk, operationalising through the National Rivers Authority, later replaced by the EA in 1996. With the absent regional representation, DEFRA assigned a yearly FRM 'block grant' to the EA, replaced funds that previously rose by the Regional Committees. The EA National Review Body was set up for a greater science input, assisting with national scale for, for instance, monitoring rivers program and flood defence work standards and a reference for justifying higher defence where it was more beneficial. This marked the start of the cost-benefit assessment in FRM (Tunstall, Johnson and Penning-Rowsell, 2004). The review bodies were expanded following 1998, 2000 and 2007 (Pitt, 2008) and the growing number of DEFRA/EA research programmes further stressed on a national strategic approach (Penning-Rowsell et al., 2005; Penning-Rowsell et al., 2013). This was accompanied by intervention moving away from engineering work towards using a variety of approaches and eventually going back to a greater Local Authority involvement.

FWMA 2010 was a return to more specialist legislation, as in 1930. On one hand, the determination of the government for stronger water legislation up to 2008 was drastically reduced following the 2010 general election, whilst trying to maintain credit for responding to the catastrophic 2007 floods (Penning-Rowsell and Johnson, 2015). On the other hand, the recent floods suggested a change in the nature of flooding. Following the Pitt review, the new legislation gave the EA a national strategic role in FRM in England, it also gave the upper tier local authorities new management power for groundwater and surface water flooding in their area. They have also been allocated financial resources to improve individual property resilience such as the property-level resilience grant, property-level flood protection scheme between 2009 and 2011, Flood Defence Grant in Aid 2011, the Repair and Renew grant scheme in respect of the winter floods of 2013 and 2014 and Property Flood Resilience Grants for households and businesses flooded in winter 2015 to 2016. In line with FWMA 2010, the Localism Act 2011 increased the autonomy of local authorities in their provision of services. With regards to FRM, the Localism Act requires the councils and the neighbourhoods to gain more control over subjects like housing and planning in the interest of their local residents. This includes making decisions on issues such as flooding (DCLG, 2011). It also emphasises on the cooperative actions between the risk management authorities. Section 9FH requires the local authorities that operate exclusive arrangement on flood risk management through the LLFAs to establish processes to enable the scrutiny committees to look over risk management authorities in their area, restated in the FWMA 2010.

There have been various efforts to reduce the responsibility of flood risk away from central-funded defences to local communities in England. The main point of scalar arguments is how to prioritise FRM strategies focused on balancing between national and local levels. In that regards, DEFRA states: A national strategy was largely '*felt to be a good thing*' however local level '*had their place and should not be overlooked*' (DEFRA, 2009d, p. 20). In 2010, following the election of Cameron government, the Coalition government advocated the philosophy of localism an adoption of partnership funding which for FRM was expressed in the National Flood and Coastal Erosion Risk Management Strategy in 2011 (Wiering et al., 2015). It

introduced a local/national system for sharing the cost of risk (DEFRA, 2011a). This marked a critical element of 'localism' into a system that was greatly centralised before. The new politics of scale encourage local organisations to address some of the local risks such as flood with the goal of local organisations and authorities to take over responsibilities from the central government. This shift from the bureaucratic state to a multi-sector civil society, state and market, entailed a strong shift in the debate of arrangement of responsibility. This alters a different aspect of stakeholders' approach in relation to the division between private and public discourse including motivations, role and characteristics of each actor, formal and informal rules for the behaviour and communication. Whilst in the bureaucratic state, the central government bears the main responsibilities, in the market and civil society, joint responsibility between public and private sectors is encouraged (Dicke and Meijerink, 2008).

Wissen (2009) argues that the concept of rescaling is an essential framework to study the risk and responsibility debate in the localism process. Pimlott, Giles and Harding (2010) suggest that localisation did not necessarily emerge as government austerity measures to reduce the state expenditure by replacing their local expenditure with locally raised resources. From a more generalised view moving towards the local level is not inherently concerned about decentralised power rather is about decentralised responsibility (Dore and Lebel, 2010). Penning-Rowsell and Johnson (2015) suggest that it was a policy which promoted engagement or local community partnership, a technocratic scheme of fundraising translated into a political instrument to share the blame for any lack of investment in protecting properties at risk. They argue that the localisation of cost-sharing brings local responsibility for both success and the failure to offer flood help. Norman, Bakker and Cook (2012) and Penning-Rowsell and Johnson (2015) put it that although the state maintains its power in by setting the 'rules of the game', the implementation is not their direct concern anymore. Hence, it seems that localism policy in FRM did not necessarily assist with the empowerment of the communities and it has been argued that the main power remains with the central government.

4.3 Governance theories and flood risk management

In the last 40 years, governance has become a widely used term and subject in a variety of school of thoughts and has been used in different ways and definitions in the literature. Originally, governance referred to the action or method of governing, managing, or steering behaviour (Jessop, 1999). In the more modern use, governance can be described as an assembly of actors and institutions with a distinct goals and a set of preferred policy instruments where actors frame an issue in certain principles, following certain practices, and the interaction between the actors, based on specific institutional features (Jordan, 2008; Watson et al., 2009; Moss and Newig, 2010). Regardless of the area of study, Lange et al. (2013) suggest that the goal of governance is to capture the dynamic of governing towards fulfilling a common goal. He outlines governance as a process of institutionalised interaction between public and/or private actors towards collective goals. Similarly, Driessen et al. (2012) suggest that regardless of the modes of governance, associated theoretical debates are based on the arrangement of actors (public body, private and civil society), institutional structures and power distribution. It has been praised as a valuable lens to understand risk management and communication (Rhodes, 1997). At the same time, it has been criticised for a fashion with a loose application and conceptual ambiguity (O'Riordan, 2004) as governance does not fall into a single universal theory and can have different meanings from different views (Young, 2005; Jordan, 2008).

Although the term governance emerged in development studies in the 1980s (Stren, 2000), it was not applied in risk studies as 'risk governance' until late 1990s and early 2000s (Elliott, 2001; Heriard-Dubreuil, 2001). The term 'risk governance' refers to interpreting the elements and principles of governance in the context of risk and risk-related decision-making (Renn, 2006; Renn, 2017) which includes both formal and informal institutions and arrangements. The term 'flood risk governance' signifies a division of risk governance, which can be defined as '*the translation of the substance and core principles of governance to the context of flood risk'* (Renn, Klinke and Van Asselt, 2011, p. 8), through which flood risk management is delivered (Renn, Klinke and Van Asselt, 2011; Alexander, Priest and Mees, 2016). It requires reflection of the complex arrangement of actors, rules, processes and mechanisms of data collection, data analysis and communication, and decision taking (Renn, Klinke and Van Asselt, 2011; Alexander, Priest and Mees, 2016). With regards to flood risk, the initial choices for governance arrangements are directly influenced, not only by the country's hydrological and physical/geographical aspects but also by its general socio-economic characteristics and governance preferences. Its features can be manipulated and reshaped through internal stabilising i.e., path dependencies and preparation mechanisms, and change factors such as agency, policy entrepreneurs, windows of opportunity, and counter-framing (Matczak et al., 2016). In this study, flood risk governance is referred to all kinds of measures deliberately taken to prevent, reduce and/or mitigate the harmful effects of flood risk.

The notion of governance can be used in both normative and descriptive senses (De Marchi, 2003) to understand how it manages the collective affairs. In its normative use, governance is described as a model or a framework forming and managing society. The normative debates are based on ideologies such as Marxism and regulation theory to explain the globalisation process. It perceives globalisation as an economic and political process where the state system is denationalising and is reducing its power, a shift away from top-down governing towards more decentred governance mechanisms (Jessop, 1999). In its descriptive sense, the idea of a complex network of various interaction between the diverse collection of actors is adopted to explain the current state of affairs concerning a policy area (Davoudi and Evans, 2005). In this sense, governance can be described as '*structures and processes for collective decision-making involving governmental and non-governmental actors*' (Nye and Donahue, 2000).

The terms 'government' and 'governance' are a helpful way to conceptualise the characteristics of changes that followed the adaptation of the idea of governance. The term 'government' refers to the monopoly of power held by the state as an institution (as an organisation and a structure). Policy objectives are defined by the state and are implemented through a strong bureaucratic process (Stoker, 2011). Classical regulation theories often consider hierarchic orientation characteristics such as top-down decisions, communication, delegation, control, and support. They award the central state a key role in guiding economic development by using various modalities (Jessop, 2007), such as rules, laws, regulations, and policies. It is often accompanied by privileged experts who control access to privileged knowledge (Watson et al., 2009). Such a central role is given to the market in the form of political economy, in the policy theories inspired by economics. As evident, in their perspective on power and control, both groups of theories agree on the existence of a dominant actor (Renn, Klinke and Van Asselt, 2011). Nevertheless, in dealing with risks such as flood, this hierarchical model of government and the related regulatory models, overlook the consideration of

uncertainties in the problem which can lead to an inadequate understanding of the obstacle to addressing risk responsibly. Often risks, including flood risk, are surrounded by the uncertainty in their factors and relationships which cannot be understood solely based on the probability and their effects (Pidgeon et al., 2005; Renn, 2017). Examples of such uncertainties include the accuracy of the predictions on probability and consequences of flooding, deciding what level of risk is acceptable (Hall, 2009), uncertainties in predictions of climate change, and methods of incorporating that into the decision-making process (Termeer, Dewulf and Breeman, 2013). There are also institutional uncertainties, with various decisions on a problem taken in different policy fields or governmental levels. The complexity of uncertainties can be further increased owing to the ambiguity of the responsibilities, solutions and goals (Van Bueren, Klijn and Koppenjan, 2003; Termeer, Dewulf and Breeman, 2013).

The 'governance' perspective asks for collective production and employment of policy solutions in complex multi-actor networks and processes (Renn, Klinke and Van Asselt, 2011). The political academic literature often uses the term governance to signify a new mode of governing that is distinct from hierarchy and instead signifies a cooperative mode where public and private actors participate in networks (Mayntz, 2003). Whilst 'government' is seen as a hierarchal system where the state has control over policy formation and implementation, 'governance' is characterised by the public and private agents who are involved in policy-making through coalitions, partnerships and networks with increased autonomy from central government. Hence, it associates itself with a different concept of collaboration between public and private sectors such as decentralisation and privatisation to characterise the scale and scope of problem-solving. Eventually, it should be noted that despite the theoretically designated difference between these two, in practice, government and governance, can, and do co-exist and indeed are co-constituted (Sikor, 2013). Founded on concepts of cooperation, participation, mitigation and sustainability, risk governance adopts a systematic approach in the process of decision making to minimise the costs of risk (Penning-Rowsell et al., 2014). It has been characterised as a dynamic process of ongoing learning and adjustment which allows for managing the complexity, scientific uncertainty and socio-political ambiguity of risk (Renn, Klinke and Van Asselt, 2011). It denotes the shift in the collective management risk issues in both the institutional arrangement and the policy process that set the frameworks for collective activities to regulate, minimise or control risk (Renn, Klinke and Van Asselt, 2011). Therefore, the governance theory focuses on the changing relationship between the state (hierarchy), the market and civil society (networks), to a collaborative arrangement based on values and norms (Penning-Rowsell et al., 2014).

4.3.1 Policy arrangements approach

The policy arrangements approach was developed to assist in understanding the synthesis of stability and dynamism in environmental policy (Arts, Leroy and Van Tatenhove, 2006). Inspired by this approach, Flood Risk Governance (FRG) can be studied through understanding its subsystems in four dimensions including (i) actors and their associations, (ii) distribution of power and resources between these actors and their influence to determine the policy outcomes, (iii) rules of the game in terms of formal rules and informal procedures of policy and decisions making and (iv) actors policy discourses and programmes. This aspects are defined by actors' takes on norms and values, definitions of problems and approaches to solutions such as their basic assumption of the policy, and the content of policy documents and measures they respond to (Arts,

Leroy and Van Tatenhove, 2006; Wiering and Immink, 2006; Driessen et al., 2012; Hegger et al., 2014). This approach is notably beneficial for analysing FRG as it comprises a wide range of concepts in the framework of policy analysis. It adopts a sociological approach by including both structure and agency- related elements of institutional analysis (Giddens 1984). Additionally, having four analytical dimensions allows for the inclusion of legal factors in the analysis process. Analysing these dimensions over time, assist with understanding the degree of stability or changes in the policy arrangements (Wiering et al., 2017). In the following sections, this study adopts Wiering and Immink (2006) categorisation of FRG's theoretical concepts; the policy discourse and political arrangement/policy network (i.e. rules, power and resources, and actors and networks).

Wiering and Immink (2006) describe the policy discourse as the content of the policy domain and methods which are described and given meaning to by the actors. This rather broad concept varies form micro level linguistic research methods to international philosophical discourse, such as Marxism or liberalism (Apthorpe and Gasper, 2014). Policy discourse can be used to reflect the actors' intentions or the applicability of specific ideas. It can also define desirable situations and suggest alternatives to achieving them. In FRG, this refers to the political theories that inspire the basic FRG principles and instruments in the form of specific arrangement for flood risk management and providing rationales for the roles and relationships of the key institutional domains or instruments (Wiering et al., 2015).

Political arrangements suggest three dimensions to analyse an institutional organisation. These dimensions include formal and informal rules (also known as rules of the game), actors and coalitions, and resources and arrangement of power. Rules lay down the institutional pattern and vision in both formal rules (for example, legislations procedural and substantive norms, divisions of power), and informal or political rules such as a political negotiation culture (Wiering and Immink, 2006).

Arrangements of actors or a group of actors can be based on a shared discourse, power relations or formal competences between them. As has been discussed in the previous sections, the governance approach represents the transition from traditional state-led, 'top-down' decision-making towards increasingly complex actor networks and non-hierarchical processes (Pahl-Wostl et al., 2013; Walker, Tweed and Whittle, 2014). That entails a shift in responsibility and consequently arrangements of power between the actors. In public admiration, it moves away from the bureaucratic state to a more market-oriented and civil society-state. Whilst under the traditional government the key responsibilities reside with the state, the civil society-state advocate sharing this responsibility between private and public actors. This adds into the variety and complexity of the relationship between different actors in the governance setting (Steurer, Bauer and Feichtinger, 2010). Some studies highlight the importance of obtaining detail understanding of governance networks, power structures and drivers of interaction between the actors prior to making an assumption that just because a network is created, actors have an equal say. The literature suggests specific cases to counteract the conceptualisation that there has been a shift from government to governance. It suggests examples that although some governance arrangement may seem to be based on multi-agency decision making, a closer examination can reveal an underlying hierarchical power structure. Grix and Phillpots (2011) suggest 'asymmetrical network governance' to describe situations where the central government retain its influence over these networks for instance by controlling resources. For instance, Skelcher (2000)

observes that in urban regeneration, training and health partnership was used to create an incentive through financial resources. By creating partnerships and controlling resources, the central government strategically forces networks in a strict framework, to ensure the central government's objectives will be met. A similar example of state control was observed in the social housing sector in England (Laffin, 2013).

Power also has been debated as a main deriving factor in the governance process. Traditionally, power is understood through the use of Foucault's description of power as the way in which society acts to regulate the norms through the behaviour of individuals. It can include legal authority, the possession and control of financial resources, creation and strategic use of knowledge, and interaction skills. In contrast to Foucault's conceptualisation relational approach, Mayo and Lukes (2012) suggest a division of being powerful as the capacity and having the means of power, i.e. the exercise or steer that capacity. In the context of governance, this division can assist with the understanding of reasons explaining the occurrence of things in certain ways that may seem unreasonable. From this view, power is perceived as a capacity that is controlled by different individuals in the process of the governance in forms such as coercion, influence, authority, force and manipulation. Therefore, it is not fixed in the relationships of the actors, rather over time and depending on different factors and influences can move from one actor to another. Taylor (2001) and Lukes (2012), propose three dimensions in explaining power. The first one has characterised the ability to make decisions. This is particularly important in a collaborative policy context. In its second dimension, power is preceded as a tool to establish the agendas for partnerships both in relation to the timeframe for action and allocation of resources. Finally, power can be used as a tool to exercise influence in the decision-making processes. In multi-level governance arrangements, the power is distributed between public bodies in the form of political authority (Lidskog, Uggla and Soneryd, 2011). In modern governance theory, power and action are assigned to a cluster of actors and institutions; therefore, it focuses on describing the variety of actor and roles, and the complex relationships between actors and dynamic of their interactions (Boyer and Saillard, 2004). In the next section, the FRG discourse and political arrangement in England are discussed in more detail.

4.3.2 Collaborative governance

As concluded in the previous chapter section 3.3, the recent characteristic of FRG in England has adopted different discourses such as post-privatisation and neoliberalism and a number of arrangements such as centralisation and decentralisations. This portrays a complex network of stakeholders that have shaped and reshaped the distribution of power, responsibilities and rules. The current arrangements can be considered as participatory and partnership which together forms collaborative governance.

In response to the complex and potentially conflict-ridden process of FRM, a collaborative arrangement for FRG has emerged to offer a more successful and sustainable implementation (Pitt, 2008; White, Kingston and Barker, 2010). They help to balance the distribution of power amongst stakeholders, and both are recognised as a way to fulfil an effective collaboration (Skelcher, Mathur and Smith, 2005). Collaborative government has been broadly advocated to join environmental, economic, and societal goals in the water management (Mostert, 2003; Wiek and Larson, 2012) which refers to a process of shared decision-making among key actors towards a common goal. It involves various complex issues and goes beyond the conventional scope of technical and environmental aspects (Magnuszewski et al., 2018). Collaborative

governance can manifest through participation and partnership. In practice, these methods often overlap and can be used interchangeably.

4.3.2.1 Participation in flood risk governance

Participation (also referred to as public participation or public engagement) arrangement for governance has emerged in planning during the 1980s and later have been adopted in flood risk management in form of legal requirements for instance, in the EU Water Framework Directive. The rationale for the participatory governance is that is has been introduced as an antidote for traditional top-down, expert models of management of risk government (Jacobson and Decker, 2008). It attempts to replace the traditional top-down and technocratic approaches by new management paradigms (Pahl-Wostl et al., 2007). After 2010, the Conservative/Liberal Democrat coalition government further favoured the local governance. This introduces change in the role of the state: a 'constraining' disciplinary role and an 'enabling' educational function which is often interconnected. Charreaux (2004, p. 1) describe it in the analogy of the role of the state as '*to supervise the children and define the rules of the game and their latitude'*. The Localism Act 2011, clearly incentivised for decentralised governance by moving towards participatory governance at the local level (Smith and Wistrich, 2016).

Participation approach can be valuable as it encourages fundamental human rights and ethics such as democracy and justice (Reed, 2008; Green and Penning-Rowsell, 2010), increase the involvement and more suitable policy solution and enhanced implementation and outcomes (Reed, 2008). However, at the same time, it can be perceived as unable to reach a mutual result, overly time-consuming and delaying critical actions (Vedwan et al., 2008). It has been suggested that individuals may not be competent or comfortable to deal with the complex decisions that involve technical tools, detailed scientific information, and risk management issues (Beierle, 2002). Additionally, there is also the risk of reinforcing the positions of the already powerful actors (Cooke and Kothari, 2001) or alter the existing power structures which can entail unpredicted conflicts rather than the intended consensus (Sultana, Thompson and Green, 2008). Nevertheless, in an overall view, this process seems to prove rather successful in promoting efficiency and accountability, and remain important in key environmental decision making, and generally, is assumed to lead to better environmental impacts (Reed, 2008; Newig and Kvarda, 2012). However, the level of success in this process can vary depending on the barriers it faces and how well these barriers are managed.

4.3.2.2 Partnership

Moving towards the local level also triggered partnership characteristics in FRM. As it was discussed in the last chapter, Flood Directive 2007 required the wider engagement of the local organisations it manifested for example, in form of partnership funding which appears to be entwined with the requirement for partnership working. There was also an emphasis on social and community aspect of risk management as a way to raise public awareness of potential threats and to encourage them to take more responsibility in managing their own risk (O'Malley, 2010). This led to introducing the Strategic National Framework on Community Resilience in 2010. MacKinnon and Derickson (2013) suggest that this was a part of the Conservative-Liberal Democrat Coalition Government's 'Big Society' programme, to reduce central government power in favour of volunteering and community activity.

Eventually, whilst a partnership often refers to a process that involves agencies and institutes, participation encouraged a wider inclusion of public (Lowndes and Sullivan, 2004). FRG in England has been subject to both intention to involve the civil society and the private partners into managing flood risk, therefore, the current state of FRG has manifested both characteristics of participatory and partnership governance. However, in water collaborative governance practices, it is common for the term 'stakeholder' to overlap both partnerships and public participation aspects (Carter and Howe, 2006). Hence, in this study, collaborative governance is the preferred term to address both.

4.3.3 Knowledge governance and risk management

As well as being governance based, flood risk management is founded on the interdisciplinary knowledge of the actors. The notion of knowledge governance concerns with understanding the processes of creation, use, retention, integration, and sharing of knowledge and how these processes are influenced by the arrangement of governance mechanism. It provides a detailed analysis of factors that affect knowledge management processes, including ability, decision-making, behaviours, belief, expectations, interest, and preference (Foss and Michailova, 2009). As a verb, knowledge management is a collection of actions that may re-shape or re-structure governance processes, towards more sustainable objectives. As a noun, it is a narrative of phenomena, offering an analytical lens to study governance structures that shape knowledge processes. In this study, the adaptation of knowledge governance as a lens to analyse study governance structures seems appropriate.

Knowledge and power form one another. Power conflicts, entail or increase the conflicting forms of reality, and vice versa (Flyvbjerg, 1998). Traditional knowledge and rationality have paramount importance amongst the states and the economic elites (Pestre, 2003). The type of knowledge employed here are those grounded in scientific reasons (Fischer, 2009) therefore, perceived environmental policy problems such as flooding as merely technical issues that require technical solutions. However, the role of knowledge in the governance process in more complicated than what is implied by rational policy advocates. Type of knowledge that is practised in decision making is influenced by power relationships. Owens (2005) argues that power and knowledge may not equally influence policy as perceived in the traditional model as in the process of policy decisions. There can be a risk that knowledge is applied selectively to justify decisions already made. This influence of power on the policy may be greater than knowledge, as knowledge is often engaged in the governance process when it is deemed to be relevant depending on the way in which the problem is framed.

Environmental governance was traditionally based on a rational scientific approach to knowledge, resulting in developing rational policy models. These models rely on policymakers benefiting from scientific knowledge to create forward-thinking solutions (Andrews, 2006). It is understood to be able to offer impersonal, technical solutions to tangible problems (Fischer, 2007). Scientific knowledge is often steered by experts. Experts knowledge refers to a social process of training where experts are granted with a social role as a professional (Eraut, 2005). In the 1990s, Scientific knowledge controversies have raised doubt in the ability of science to offer solutions to policy problems (Whatmore, 2009) specifically for problems that cannot be easily and certainly framed though scientific knowledge, such as the risk of the flood (Donaldson et al., 2013). In response to that, a rethinking of who and what knowledge needs to be incorporated in the decision-making process was suggested (Donaldson et al., 2013).

However, this approach is criticised for its limitation in identifying the relationships between knowledge and power. In this approach, the knowledge used in public decision making is produced, communicated and advocated on behalf of scientists who make only a small segment of the society. In dealing with natural hazard issues such as flood risk, it can be problematic as the existence of a diverse group of stakeholders and consequently different types of knowledge is unavoidable (Donaldson et al., 2013). Broadening the participation in decision-making can help to offset this limitation, and comprising inputs from outside of the initial knowledge set can be appropriate and valuable (Krahmann, 2003, p. 327). Similarly, in the context of FRG, whilst incorporating the expert knowledge as one form of legitimate knowledge is appropriate it should be realised that other forms of knowledge can have valuable inputs to the process of policy. Following the devolution of power in flood governance, a newly valued area of knowledge in the process of adjusting policies to the local level was suggested to be local information and lay knowledge. Hence, it is important to understand the difference between these two types of knowledge and their roles and limitations in the governance process.

Moving away from separating expertise and lay knowledge in the traditional models, knowledge management has moved to a new phase where the boundary between lay and expert knowledge is blurred and there is a question as which one holds the truth and therefore is more valuable (Collins and Evans, 2002). Both forms of knowledge are suggested to be socially constructed; and neither are as dissimilar from 'practical reasoning' as suggested by traditional rationalists (Healey, 2006). On one hand, experts' knowledge is produced in the specified framework and agreed on boundaries that grant them legitimacy. Therefore, it is accountable for the level of its validity and quality (Lane et al., 2011). On the other hand, however, each area of expert knowledge distracts itself from other fields through certification, specialist language and creating a culture which may not be easy for an outsider to imitate. In the management of the flow of information, thus, these boundaries will prevent non-experts from benefiting from expert knowledge, and contributing to it. Such limitations are further pronounced in knowledge production and interdisciplinary literature. It is suggested that knowledge and expertise exist in different and disparate fields and there is no simple method that experts' knowledge in one field can be used directly by expertise in an unconnected field (McNeill, 1999). This means that a separate field of knowledge is possessed by separate groups of expertise, therefore, expertise in two different areas are not directly exchangeable. Further to that, due to the interdisciplinary nature of practical problems, there may not be a suitable core-set of professionals (Rip, 2003).

The concept of knowledge governance is closely linked to organisational learning and knowledge management. Although the two concepts overlap in different aspects, they are different in their relation to the mutual aim of a successful process of knowledge and learning outcomes. Organizational learning concerns the process of improving employees' outcomes by incentivising them to improve knowledge and in a particular area. This is done through developing organisational adaptation in response to the changes in the environment (Pemsel et al., 2014). It focuses on studying activities within firms rather than between them. Knowledge management, on the other hand, refers to the management of knowledge through improving the cycle of knowledge i.e. collection, sharing and practice within the organisation. In its collaborative form, knowledge management refers to organisational knowledge management systems that are used across

organisational boundaries to generate and control knowledge resources and properties collaboratively (Abdullah et al., 2007).

Despite the suggested benefits of inter-organisational knowledge exchange, these activities bear some challenges in collaborative scope which can be put into three categories. The first group of challenges are associated with Human barriers such as communication expertise, social networks, trust, and recognition of the benefits of collaborating in information exchange (Jain and Jeppe Jeppesen, 2013). The second category concerns technology limitations that refer to the unifying and integrating information technology systems and processes, technical support, system conservation, technology reluctance, and need for preparation of staff (Othman et al., 2011). The last group is organisational barriers that include reward systems, top management support, organisational structure and culture, strategies, policies, and resistance to change (Titi Amayah, 2013). Lack of motivation, incentives and promotion of knowledge-sharing culture also fall into this category. Additionally, Yang et al. (2014) suggest that the reason for the absence of limited joint activities in exchange of knowledge and experience between partner firms can drive from cognitive distance and conflicts of interests that are present between organisations. They argue that each firm is independent units with different and specific mental models and organisational aims. These differences can cause unsuccessful flow, transfer and knowledge integration between the organisations (Nooteboom et al., 2007). Even when the attempt is to bridge this cognitive distance, there is a risk that the subsequent cognitive proximity leads to the opportunistic organisation to internalise the knowledge property of the focal partner compromising what has been agreed on (Mohr and Sengupta, 2002). However, Yang et al. (2014) suggest it is possible for firms to protect their core knowledge property in the process of knowledge exchange. They argue through a common mental model, the focal firm can bridge the cognitive distance between partners. This can be achieved through interactive learning and mutual commitment.

In summary, knowledge governance is perceived as a multi-actor process which can be adopted in different levels and different concepts. FRM in England portrays a dynamic nature of knowledge formation practices which began as a mostly science-oriented policy area relying on expert knowledge from different policy areas and regulatory agencies. Knowledge and its basic forms (information and data) not only are a core element in constructing FRM cycle, but also a key factor of change from risk government to risk governance where governance mechanisms can steer and effect knowledge management processes (Foss and Mahoney, 2010). This opens the opportunity of adopting the changes of data and knowledge governance as a lens to analysing power arrangement and network and relationship between the key stakeholder groups.

4.4 Conclusion

In this chapter, a conceptual framework is developed for analysing the theories and concepts that have contributed to the change of the current state of FRG to the scale of property level. It has highlighted the link between collaborative governance and the drivers of re-scaling to the local level and demonstrated that it comprises four key factors including discourse, rules, power arrangement and actors and collations. The complete conceptualisation can be summarised in Figure 4-2.

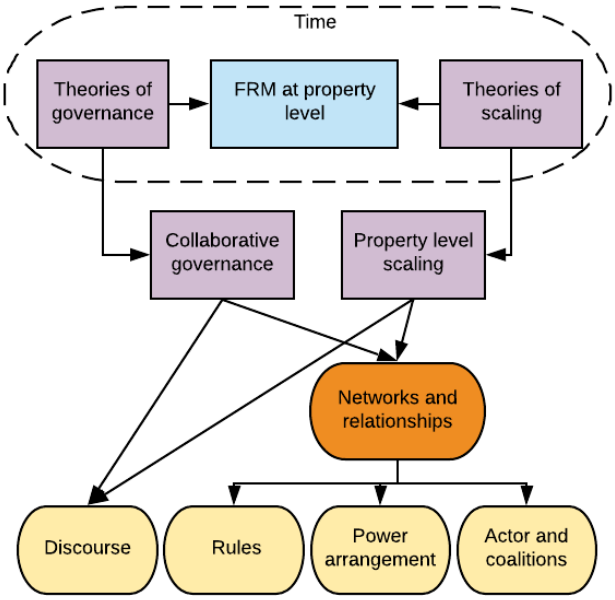

Figure 4-2 Conceptualising change in Flood risk governance at the property scale

This conceptualisation was achieved through three stages. First, analysing the key concepts and theories to assist in identifying the main components and dimensions involved in the process. This includes the theories of governance and scale policies. The two concepts of governance and scale were presented to explain how FRM has been organised and managed by various actors and institutions and how its scale took different arrangements over time. Here, knowledge governance is deemed a useful theoretical lens and exchange of data will provide a tool for an in-depth analysis of the current arrangement of actors and their relationships and reasons contributing to this stand. Finally, a conceptual framework was developed to be used in the analysis of change in FRM at the property level. It echoes the transition of FRM and risk governance to a complex structure of multi-actor and multi-criteria process for dealing with risks with its responsibility being shared between local and national scale.

Through developing a conceptual framework for analysing FRM at the property scale, this chapter has identified a structured view to analyse this area. It was debated that whilst this structure and notion of complexity have been reviewed at various spatial scales, there has been very limited evidence at the property scale. The focus here is to investigate the dynamics between the key actors, the changes in the arrangements of power amongst them, the key driver that shapes these arrangements and the ideologies behind them. This can assist in answering the question of what is happening in this specific context of FRM at the property scale in England.

Investigating this gap can be challenging as many of the reasons and incentives behind their decision-making process are not publicly and sometimes organisationally shared with those involved with the process. Therefore, careful thought must be placed on structuring the information gathering process to obtain what is alluded to or limited to certain representative stakeholders involved who are knowledgeable about the process of change. This can only be achieved through the use of in-depth interviews for the data collection alongside using multiple other sources. Elements that must be strongly represented in the philosophical position of the research are outlined in the next chapter.

Chapter 5: Methodology

5.1 Introduction

In the previous chapters, the research background and the gap in the knowledge were discussed. It was concluded that whilst a considerable amount of information can be gathered from literature, the concept of property level flood risk data is relatively unestablished. This necessitates liaison with primary sources (i.e. key stakeholder groups) in order to investigate reasons for this discrepancy.

This chapter provides details of the research approach and justifies the selected research method in collecting and analysing the required data to accomplish research objectives presented in Chapter 1. Based on the strategy and methodological considerations for this study, three sections were developed comprising: a conceptual framework (Section 5.2 data collection methods (Section 5.3), and data analysis methods (Section 4.4). This chapter closes with methodological limitations and ethical considerations.

5.2 Conceptual framework

In chapter 2, the components of flood risk management in the UK (FRM) and the role of risk management stakeholders and property level data were explained. On one hand, the significance of property level Flood Risk Data (PLFRD) for the use of stakeholder groups was highlighted in three government documents i.e. DEFRA 2010, DEFRA 2011 and EA 2010 (a number of recommendations were made to instigate improvement of such data to comply with the needs of engaged stakeholders, accordingly). On the other hand, the currently common practice amongst the key stakeholder groups suggests a restricted use and availability of such data.

Following the developed conceptualisation in the previous chapter, it was evident that there is a lack of foundation of existing knowledge that can be used to identify and test the components of flood risk governance at the property level. This is mainly due to the reason that motives and drives that contribute to the formation of these components often do not appear in the actors public pronouncements. Similarly, due to reasons such as negotiations between the key players are often behind closed doors, there is very limited written evidence available to characterise or explain these concepts. Thus, a more exploratory, inductive approach should be used to analyse the complex position of stakeholder groups and their relationship in this context. By starting with observation, the research can begin to detect patterns that can lead to hypothesis and finally theory (Bryman, 2015). This type of exploratory method has been found useful in exploring relationships between concepts and phenomena (Saunders et al., 2009). As an inductive approach focuses more on the creation of theory as opposed to a deductive method of testing hypothesis, it is more applicable to the exploration of how people collectively construct their views of the social world. Therefore, a qualitative research strategy is best suited to gain the insights needed to theorize the constant shift in social reality (Bryman, 2015). Common qualitative research methods include observation, interviews, focus groups and document analysis. Although some researchers critique the validity of this subjective method because of possible issue of generalisation, transparency and restricted ability to replicated data, this

method is no less valuable than scientific methods of inquiry (Bryman, 2015; Ritchie et al., 2013). Hence, in the specific context of this study, a qualitative was developed to address the objectives.

Prior to outlining the conceptual framework of the study and research methods sections, it seems necessary to briefly outline the scientific orientation of this study. This research focuses on exploring the merits of property level data from the view of the key flood risk management stakeholder groups. The intention is not to explore the physical nature of such data from an objective perspective (such as flood depth or building material performance), but rather to understand how such data is perceived by the key stakeholders. This premise is the foundation of methodological assumptions used in this research and guides the relationship between the researcher and the research and how research is investigated. Social science research is commonly categorised as either objectivist or subjectivist (Burrell and Morgan, 2005; Ponterotto, 2005; Mackenzie and Knipe, 2006). Objectivism sees the world from a realist/positivist perspective with a focus on quantitative data. On the contrary, the subjective view is more nominalist in nature and is based on abstract reasoning and subjective/constructionist interpretation and usually relies on qualitative data. In this view, the social world is a phenomenon created by shared experiences and interaction between the participants and other sources (Charmaz, 2014), and the role of the researcher is thus to construct an impression of the world as she sees it (Ratner, 2008). Following the aim of this study, it mainly views the social world as concepts collectively created by individuals to structure reality and focuses on direct experience and interpretation. The general view used here is subjective in nature (Cohen, Manion and Morrison, 2007; Grix, 2004). The methodology will dominantly focus on the experts' inquiry and comparative analysis of their views to explore the case for Property Level Flood Risk Data (PLFRD). This will require 'getting close to one's subject' (Burrell & Morgan, 1979:6) to understand specific situations and subjective perspectives that can lend insights to the process under study.

One of the core ideas of social constructivism research is that facts do not simply exist but are generated through social interaction. This provides a strong motive for critical research in the social sciences and defines the researcher's role and responsibilities in the research process through acts of representation and interpretation of the subject (Ranter 2008; Flick, 2014). This requires the researcher to uptake an important active role in all aspects of the research, instead of being merely a passive observer of the social world (Lincoln, 2004). These roles include choosing 'social groups' or 'cases' of interest to the research (Merkens, 2004); interview subjects; the gathering and interpretation of data, and the manner in which this data is structured and presented (Hamilton, 2015). Additionally, the interview experience itself is shaped by a variety of choices and contingencies that resulted from the mutual interaction between the researcher and the interviewee. This is the result of what Hermanns (2004) calls co-produced knowledge.

Following the clarification of scientific orientation that this study is subjective/constructivism, this section continues on developing the conceptual framework of the study. To recap from Chapter 1, for achieving the aim of the research, the following key objectives were put forward:

Objective 1: To understand and clarify

a) Components of flood risk management and their definitions at the property level with the focus on the role of data

b) key actors and the evolution of their role in managing risk to individual properties

Objective 2: To develop a conceptual model of the relationship between flood risk governance and scalar arrangement.

Objective 3: To identify critical elements that characterise flood risk governance in England at the scale of property level based on in-depth expert interview approach. This will comprises appraising the key influential factors in facilitating property level flood risk data with respect to the needs and requirements of key stakeholders and ascertain opportunities and barriers where applicable.

Objective 4: To contribute to the evidence based flood risk governance, particularly in the context of multi-sector risk governance at the property level scale.

Objective 1 was addressed through a literature review as presented in chapters 2 and 3. In line with the findings in the literature, and the aim of the research, a conceptual framework was developed in chapter 4 to bring together the associated theories and concepts and suitable methodology to and address Objective 2 and Objective 3. As stated in the previous chapters, whilst a variety of guidelines and recommendations are available for improving data in general and flood risk management data in specific, including the recommendations in DEFRA 2010, DEFRA 2011 and EA 2010, there was little evidence traceable in the literature regarding suggested improvement in such data. This raises the main research question 'is there a case for property level flood risk data?'. This framework is presented in Figure 5-1.

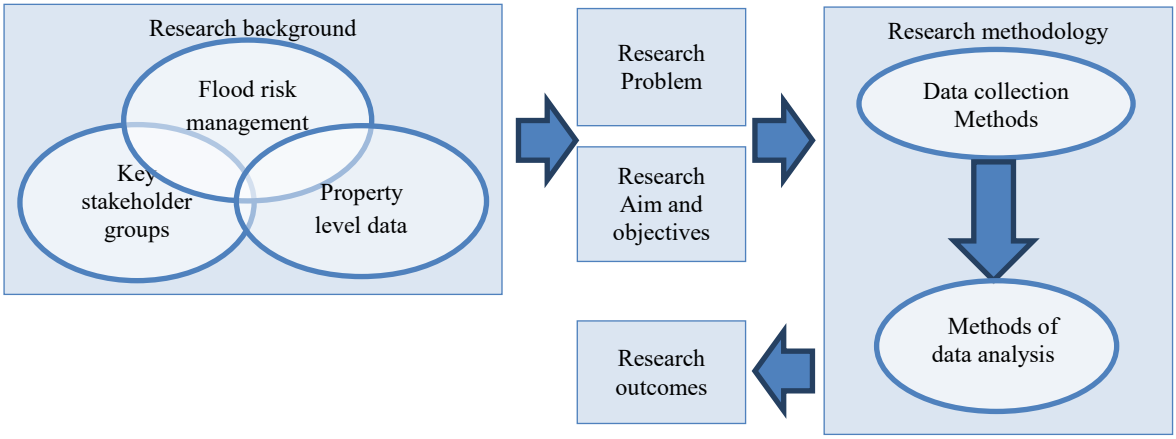

Figure 5-1 Conceptual design framework

At this stage, based on a series of decisions made on how to conduct the study (Burns and Grove, 1997) design was developed to ensuring that the evidence obtained enables the research to effectively inform the research objectives. Figure 5-2 illustrates this research design in four stages comprising; consultation regarding current practice in key stakeholder groups, data collection through in-depth interviews with experts, followed by transcription and analysing data and finally appraisal of the key influential factors to facilitate property level flood risk data in respect of the needs and requirements of key stakeholders. The details of the various steps adopted for research design are discussed in more detail in the next subsections.

This design divides the content of this chapter into two sections namely data collection and data analysis, presented in Figure 5-2. In the first section, the method selected for data collection and decisions that

informed this process is presented. This includes semi-structured interviews with experts, complemented by observation and document analysis (triangulation) (Stage 2). These sources of data collection were each geared towards understanding the formal and informal practices adopted by experts engaged in the topic under investigation. Eventually, these data sources were found to be concordant and complementing one another. This helped the study to minimise the interpretive bias of the results and to expand their generalisability. The combination of complementary methods and relying on two or more sources of evidence, i.e. triangulation, can help to compensate the shortcomings and weaknesses of single methods, deepening and widening the researcher's understanding and consequently, offer a more comprehensive representation of the social world (Tashakkori and Teddlie, 2010; Bryman, 2012; Flick, 2014). This section is also informed by findings of literature review and preparatory activities (consultation with experts) which were conducted prior to fieldwork. This section is designed to support both analyses required for meeting Objective 3.

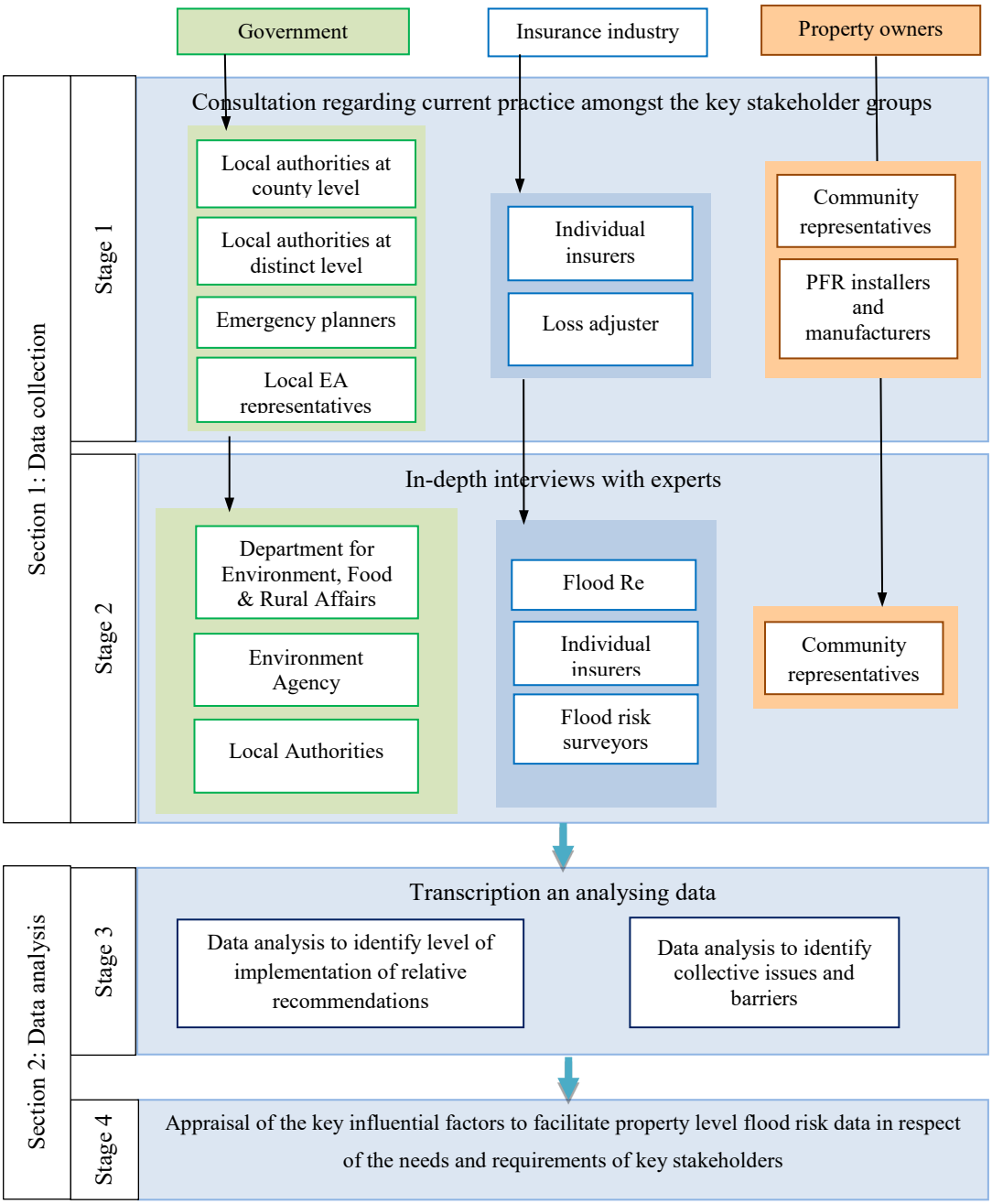

Figure 5-2 Research design

In the second section, methods adopted for the analysis of the collected data discussed for the aforementioned objectives are accordingly discussed in two subsections (stages 3 and 4). Details of each stage are presented in the following sections.

5.3 Data collection methods

5.3.1 Stage 1: Preparatory actions

Informed by the information obtained in the literature, prior to fieldwork, the design structure began with an initial consultation with a number of key stakeholder groups' representatives regarding the currently common practice of PLFRD. Between September 2015 and February 2016, the preliminary consultations were conducted with local authorities, community representatives and private insurers. The selection of

consultant individuals was on the basis of their responsibilities and history of expertise in the specific areas of property level data. In total 10 one-to-one consultation meetings were conducted, each lasting approximately 1 hour.

In addition, several exploratory talks with the experts in several flood risk related conferences were held, the results of which assisted to validate the findings from the literature, to articulate the research problems, and to inform the development of appropriate research design. It also informed the subsequent selection of key informants interviewed for data collection in Stage 2. It became evident that individuals' insight in each stakeholder group can be limited to the area of their organisational responsibility their history of engagement in the area. This indicated that the number of experts who can provide a thorough insight into the topic is relatively small, therefore, interviewing one or more of these 'key players' in each group would be beneficial.

5.3.2 Stage 2: In-depth interviews with experts

In-depth interview methodology relies on the selection of 'good informants' (Flick, 2014) to create a balance between the time required for conducting and transcribing the interviews (in this study 15 in total), and to ensure the quality of the collected data (Merkens, 2004). At a minimum, a good informant (interviewee) should possess practical (or 'operational') knowledge of the research subject, with a willingness to participate in the study (Pfadenhauer, 2009; Flick, 2014). Additionally, like other sources of empirical data, this selection should represent as many different aspects of the topic under investigation as possible (Merkens, 2004). With the view of these considerations, this stage comprises three steps: the process of selecting the experts, detail of data collection and the choices made for the formulation of the questions.

5.3.2.1 Selecting experts

Experts are those with some degree of responsibility for the development, application or control of a particular topic or individual who has privileged access to information concerning a group or decision processes (Meuser and Nagel, 2009). Hence, they possess knowledge that is beyond the normative perspective of non-experts (Jasanoff, 2003). The distinction of an expert rests upon his or her subjective judgments and their thorough familiarity with the problem in question. This thesis draws on and tends to favour the term 'experts' to characterise the research informants. These individuals, although coming from a variety of professional backgrounds, share something in common as 'first-order observers'. Experts were selected from three key stakeholder groups categories introduced in Chapter 3. The designation of expert interviewees was based on their professional titles, job descriptions and backgrounds experience in engaging at property level flood risk management and data. Also, literature review and documents analysed, identified some of the key organisations and individual experts directly engaged in the PLFRD within the three key stakeholder groups. It should be underlined that there is no single, uniform government body, an insurance company or individual community to speak of, rather there are as Hamilton (2015) suggests a constellation of experts engaged in the specific problem.

It was also evident in the early stages of the literature review that a small number of flood insurers tend to be credited as leaders in the field. These experts frequently described themselves as having property level

insurance backgrounds in a different level of operation in the organisation which subsequently formed the basis for their careers as property flood risk underwriter specialists. Similarly for Government, as discussed in Chapter 3, the number of regulatory bodies and individuals within those bodies that tend to dominate the preparation and dissemination of flood risk data with policy role is limited. This matter became distinct, within the preparatory consultation stage and consultation with government stakeholder groups.

The initial preparatory meeting within individual homeowners, in combination with the evidence available in the literature, suggested a great diversity in how individual homeowners experience flood risk and respond to it. Their experience and how they perceive flood risk data (O'Sullivan et al., 2012) is affected by a wide range of factors. For instance, their previous experience of flood, awareness (Kelman, 2005), amount of support they have been having before and during a flood event (Tapsell and Tunstall, 2008), and their level of risk ownership (Harries, 2008). It was soon realised that it is beyond the timeframe and resources of this study to identify a satisfactory number of homeowners to gain a general view of the matter, who are both willing and able to discuss their views on changes that may have affected availability and use of PLFRD to them. Therefore, in order to be able to project a better overarching view of homeowners experience and views firstly, the researcher relied on available literature and publically availed resources. These included videos and news reports that are available in the public domain, and empirical studies that included interviews with homeowners with direct quotations on their experience and resources available to them. Additionally, the primary contact suggested the contrast between the notion of expert and expert's knowledge to that of lay people's. In the context of an environmental issue, this contrast is known to be problematic (Blok, Jensen and Kaltoft, 2008). Therefore, in order to provide an equal ground for comparison of views and experience of all the three stakeholder groups, experts from flood community representatives, at both managerial and on-site experts were selected for further discussions. Owing to their longtime experience in working with individual homeowners at risk these representatives facilitated a detailed valuable insight that connected property owners' perspectives to a broader policy level context. Through this approach, a comprehensive perception of numbers of communities at various locations, affected by different floods, was obtained.

Often the designation of experts was also difficult for the other two categories, due to the complexity of the structure or size of the institution. Identifying individuals with specific expertise and knowledge in the area under investigation was challenging, or the designated organisation (or individual) rejected the request for an interview. At the early stages of data collection, it was realised that being granted access to interviews with some of the experts in a number of organisations such as the EA and Flood Re can be difficult. The difficulty of gaining access was partly mitigated by contacts that were made following the one-to-one expert consulting meetings (in stage 1) contacts made in several conferences, and attending relative research dissemination events and workshops. Each of these events focused (or included specific sessions that focused) on data, information and improvement of resilience in the built environment to a varying degree where several overarching themes emerged. These workshops and conferences include:

Flooding 2015: Risks and Resilience (27 January 2015, London), Property Flood Resilience Database Project (PFR-d) dissemination event (6 July 2015, BRE Watford)[1], IDEA project progress meeting (10-11 September 2015, Madrid), Resilience15: flood resilient and adaptive built environment (4 November 2015, BRE Watford), IDEA project working week[2] (23-27 November 2015, Milan), IDEA project workshop with external stakeholders (5-6 April 2016, Oxford) [3], Sesame project dissemination event (16 May 2016, Tewkesbury)[4], and FLOODrisk 2016, 3rd European Conference on Flood Risk Management 2016 (18 to 20 October 2016, Lyon).

The initial list of candidate's interviewees was developed following the literature review and the preparatory activities discussed in section 5.3.1. Two key criteria were followed in order to ensure that the selected individuals can represent the variety of roles and PLFRD related responsibilities in the key stakeholder groups. With regards to the government organisation, this was followed by the organisational hierarchy of flood risk management from national to local including DEFRA, the EA, recovery and emergency and local authorities. Representatives from insurance industry were selected from a variety of experts with an expertise in a variety of fields including representatives with experience in the area of property underwriting, risk management, reinsurance and risk pricing, loss adjuster and property surveyors and technicians who directly works with data. The initial list of the candidate was further expanded during the course of interviews using a snowball sampling technique (King, Feltey and Susel, 1998; Stanghellini and Collentine, 2008). Following this technique, interviewees were asked for their knowledge on possible candidates from the three key stakeholder groups who can provide this researcher with insight to the topic. Special attention has to be given in the snowball technique due to the risk of reproducing network homogeneity. A more balanced set can be created by using multiple entry points (Luyet, 2005).

During the course of interview sessions, the performance of the researcher benefited from the experience and knowledge she obtained during involvement in the European project, Improving Damage Assessment to Enhance cost-benefit Analyses (IDEA[5]) as a research assistant. IDEA was an EU funded research project aimed at improving data collection following natural hazards such as earthquake, flood and landslide in

[1] It was an Innovate UK funded feasibility study project with the aim to enable insurers to understand the flood resilience measures that are taken in properties and use the available information to assess the improved resilience and amended risk levels for these properties.

[2] Activities conducted during this week included workshop on data analysis for disaster forensic, working with real data to perform a forensic analysis, workshop on data analysis for the development of the information system, and working with real data to define quality of data/functional requirement.

[3] Both of the mentioned IDEA project meetings were hosting a multi-national community of stakeholders interested in detailed flood risk data representing different groups of experts including insurers, emergency responders.

[4]Participants include local businesses and those that work with them in local resilience building. Further information about the SESAME project can be found at sesame.uk.com

[5] The case study of the UK partner was Severn flood in 2007 in the UK. The project was conducted in Architectural Engineering Group of the Oxford Brookes University. More information can be found in http://www.ideaproject.polimi.it/

order to allow for more effective mitigation measures and inform pre-flood risk modelling. From the early stages of this research, the researcher was involved in different stages of data collection and analysis process, and associated meeting and workshops. This opportunity gave the researcher wider experience in understanding the flood risk management data prior to the data collection stage and helped to establish the primary links with the stakeholder's groups. Together with the knowledge obtained from the literature and the preparatory consultation in Stage 1 of research design, this background enabled the researcher to (at least in part) "speak the same language" (Heyl, 2001, p. 371) as those being interviewed. In essence, this helped the researcher to be able to demonstrate a 'thematic competence' in the subject under discussion (Pfadenhauer, 2009, p. 90) and helped her to take the role of 'quasi-expert' (Pfadenhauer, 2009, p. 91) to conduct a higher quality conversation.

Data in this study has been gathered through a series of in-depth semi-structured interviews with experts, who represented different stakeholder groups as demonstrated in Stage 2. In total, 15 interviews with the property level flood risk experts were conducted. The main criteria considered for achieving a suitable sample size was saturation. In an in-depth interview method, qualitative research scholars often suggest saturation as the most important factor to consider (Mason, 2010). Saturation is described as the stage at which the data collection process offers no new or relevant data (Charmaz, 2014). It depends on various factors such as the level of homogeneity of the population being studied, resources of the study, and when the collected data ensures the depth, relevancy and range of concepts and characteristics that are considered critical for emergent findings (Strauss and Corbin, 2007) the nature of the topic, and the amount of useful information obtained from each participant (Morse, 2000). Table 5-1 presents the list of interviewees including their title and professional experience, representing three categories of stakeholders discussed in Chapter 3.

Table 5-1 List of interviewees

Interviewee		Interviewee position	Relevant knowledge and experience
Government representatives	1	Current DEFRA policy adviser	Experience in working with the several local authorities and communities
	2	The EA research scientist	Expert in flood research and flood modelling at the national and local level
	3	The EA development and flood risk engineer	Experience in collecting information following a number of national and local flood events, the experience of working closely with communities during and after flood.
	4	Civil servant at the Ministry of Housing, Communities and Local Government (MHCLG)	Policy advisor in flood recovery team which is a part of the Resilience and Emergencies Division (RED) within MHCLG.
	5	Lead local flood authority	Flood risk manager, Consultee for the major planning application in their area and have responsibility for county drainage team and also liaise with all district councils on flooding and all their flood risk areas.
	6	An Environmental protection service manager in flood resilience and land drainage	Over a decade of experience in working with the communities and individuals at risk, dealing with a range of flood solutions floods. Experience biding for community

			and property level flood aiding funds.
Insurance industry representatives	1	Chief underwriter officer	Extensive experience in a premium setting the underwriting roles for individual properties
	2	Head of home insurance pricing	General Insurance for Personal Lines-Property experience for over 6 years.
	3	Property risk control manager	Internal Geographic Information System (GIS) manager of a leading flood insurance company, including managing companies geo-based proposition for customers ensuring accurate pricing and monitoring. He is also responsible for risk (including flood) management solutions for the residential household.
	4	GIS Manager and technical pricing and analytics	On hand experience of working with property level data in a leading flood insurance company, involved with developing risk maps and risk portfolio.
	5	A senior member of Flood Re	Extensive expertise risk management and reinsurance,
	6	Property surveyor	Chartered Building Surveyor with extensive expertise in large domestic losses and damage data
Community and individual homeowner representatives	1	Managerial role in community representative organisation	Experience in linking the need of individuals at risk with policy influencers and policymakers.
	2	Flood recovery and community Supporter	Over a decade of experience in working with several communities and individual homeowners across the country
	3	Former senior civil servant, former director of a community interest company	Member of "Data provision and transparency ", working group 2 during the development of DEFRA 2010 report. Experience in working with the communities at risk.

Interviews were conducted between 1st October 2016 and 23rd February 2017. Each interview lasted between one to three hours depending on the expert's extent of knowledge and experience on the specific topic under question. The stakeholders were initially contacted via email or telephone call. All interviews pre-arranged and conducted in the offices of the participants with the permission of their organisation. Following the permission of the interviewees, all the interviews were recorded and transcribed word for word.

5.3.2.2 Selection of interview questions

In order to select the interview questions, each aspect of PLFRD was investigated through 12 recommendations directly concerned with the aspect under investigation were selected from the three key documents discussed in Chapter 2, DEFRA 2010, DEFRA 2011 and EA 2010. Table 5-2 presents different aspects and the original statement of the recommendation used during interview sessions.

Table 5-2 Selected aspects of PLFRD to guide the interviews

Aspects of PLFRD	The original statement of the recommendation
1) Incorporating property level protection data into the insurance underwriting	*DEFRA should commission a research project to look at incorporating localised flood risk information, including information on property-level protection, into insurers' underwriting (DEFRA, 2011b, p. 13).* *The benefits of doing this [Property level flood resilience and resistance uptake] should be passed on to the property owner in the form of reduced insurance premiums (DEFRA, 2010b, p. 45).*
2) Proof of the effectiveness of property level risk	*ABI and BIBA [need] to work with DEFRA to develop evidence around effectiveness and impact of property-level measures, so that these measures may be taken into account by insurers in the future (DEFRA, 2011b, p.26).*

mitigation measures	
3) Standard risk assessment data	*Finalisation and active use of a consistent survey method/template for the survey/loss adjuster and insurance industry... This template should be designed to capture more consistent property level flood risk assessment (DEFRA, 2010, p.63).*
4) Standard damage and claims record	*Finalisation and active use of a consistent survey method/template for the survey/loss adjuster and insurance industry ...Encouragement for the insurance industry to adopt a standard format for the future collection of information relating to household and commercial claims (DEFRA 2010, p.63).* *The ABI and Environment Agency to continue to work together towards sharing flood extent and claims data (DEFRA 2011b, p.14).*
5) EA as the single source of data to realise the impact of risk	*We [EA] will develop a dataset that will include information about the sites affected by flooding, including properties… This dataset will be the single source which we will use to understand the impacts of flood and coastal risk (EA, 2010, p.9).*
6) Awareness of information sources and data accessibility	*Action by the Environment Agency to increase the awareness of Environment Agency products and commercially available environmental constraint reports via the internet (DEFRA, 2010, p.67). DEFRA and the Environment Agency to work together to make flood risk datasets more transparent and accessible (ibid. p.20).*
7) Developing a tailored report tool to reflect end users' needs	*Development of report tools relating to property level flood risk data which are relevant to the needs of users (DEFRA, 2010 p.60).*
8) ABI sharing data with the EA	*Security controlled supply of claims data between the insurance industry and Government departments (Environment Agency) (DEFRA, 2011b, p.66).*
9) Data sharing between LLFAs and EA	*Encouragement of local authorities to supply details of the location of previously flooded properties to the Environment Agency (DEFRA, 2010, p.66).*
10) Enriching EA area based maps with property level information	*A greater range of the impacts of flooding and coastal erosion and the risk of flooding to a property level will be considered… We [the EA] will assess whether we should now be mapping to that [property level] scale…Investigate whether we [the Environment Agency] can realistically assess the risk to the property level in a cost-effective way and if so, determine whether we need to take a risk-based approach to the application of that method (EA, 2010, p.9).*
11) Risk communication and blight	*Education is required to inform property owners of solutions to minimise the impact of flood events… Solutions and benefits should be communicated in plain English and case studies of success stories presented showing how measures can be funded (and associated costs)… Information on flood risk should form part of the information provided by developers with a new property in flood risk areas (DEFRA, 2010, p.45).*
12) Licensing arrangements and restrictions on access	*[for engaged parties to] Finalise the scope and licensing arrangements for sharing of non-sensitive information between professional partners (DEFRA, 2010, p.66). Licensing large datasets entails a large cost, which has to be weighed upon a cost-benefit basis (Ibid, p.44).*

Each recommendation/PLFRD aspect was discussed using three questions: (i) what were the incentives resulted from these recommendations (or relevant to the 12 aspects under question)?, (ii) if none, why?, (iii) do you think these topics are valid for the stakeholder group you are representing? Having that in mind, through these questions, each group 's level of interest in a different aspect of property level data have been

evaluated and consequently used to identify the key barriers and opportunities concerned with the future of the property level data.

5.4 Data analysis methods

Following the process of data collection in the previous section, the obtained information was analysed in two stages, Stage 3 and Stage 4, which were to address Objectives 3. Prior to describing the analysis techniques for interviews, it is important to note that the analysis phase is a continuous progress, hence, it is not always possible to clearly distinguish the collection and analysis phases from each other. As each interview is conducted, more knowledge is gained about both the studied phenomenon (enabling a deeper investigation level in the next upcoming interviews) and also opportunities for potential other experts to be interviewed. Therefore, it needs to be considered that there may be some overlaps between the different stages.

5.4.1 Stage 3

The reason for selecting semi-structured interview was to let the researcher explore the pre-set topics and provide uniformity, but also to facilitate the freedom for extending the exploration to new themes where appropriate. Accordingly, information on the transcribed text was labelled and broken down into themes, some of which were pre-set (i.e. the 12 aspects presented in Section 5.3.2.2) informed by literature review. In correspondence to the objective 3, for each pre-set theme, the view of three stakeholders was compared and analysed to outline the level of implementation of the recommendations, analyse their validity at the time and analyse the promoting or prejudicing factors for the implementation of the recommendations. Similar and dissimilar (or even contradicting) traits between respondents who represented the same themes were investigated. For each responder, themes were coded throughout the transcribed text to analyse patterns using diagrams. The final versions of these diagrams are presented in the summary section of chapters 6, 7, and 8.

The data collected for each recommendation was first analysed in its own right to extract trends and preferences of each group of stakeholders. This enabled the comparison of results between stakeholder groups. To avoid repetition and to provide consistency in meeting this objective, the results were presented in three categories i.e. data consistency and standardisation, data sharing and communication, and property level flood protection data, presented in three chapters of 6, 7, and 8 (in this study are referred to as the analysis chapters). These categories follow the categorisation of issues addressed in DEFRA 2010, DEFRA 2011 and EA 2010. Using tables and diagrams, key common issues and opportunities for each category were extracted. This assists with generating insights between the themes, identifying relations and generalising the results within the developed conceptual framework. Where necessary, document analysis was conducted for further investigation of the initiatives noted by experts and to supports the findings of the interviews. The results of these findings were used in the narratives of the analysis in the relevant chapters. The conceptual categories and themes identified in the earlier literature review, as well as further patterns visible in the interview texts, formed the basis of the analysis chapters.

5.4.2 Stage 4

Drawing on these findings in Stage 3, the method described in this stage is to address Objective 3 *to identify critical elements that characterise flood risk governance in England at the scale of property level based on in-depth expert interview approach'*. Merging the diagrams that were developed based on the analysis of individual recommendations; informed a wider view of an aspect to investigate the common overarching patterns, relationships with influencing factors and trends. This process assists in generalising the key findings of the study. Results of this analysis are discussed in the final chapter.

5.5 Limitations

This research focuses on the data regarding the physical effect of flood risk on domestic properties in the UK as perceived by the key stakeholder groups. Management of flood risk at the property level and use of relevant data engages a diversity of interest groups such as architects and planners, emergency responders, flood resistance and resilience product producers and research and academic organisations. Due to the limited time and resources provided for this research and the specific aim of this research, the data collection remained focused on the groups that were understood as key stakeholder groups within the UK historic and regulatory context. This, to some extent, excluded other stakeholder groups (who still have a stake in influencing the future direction of property level flood risk data) from this discussion. At the early stage of data collection, it was realised that a number of experts who can provide insight into the topic was a relatively small community. Within the key stakeholder groups, selections of candidates were highly driven by their experience and interest in managing flood risk at the property level. For this reason, there might exist concerns with regards to potential bias due to the position of the interviewees in promoting PLFRD. This effect was minimised, due to the independent nature of this study, both in financial level and the ties between the research and the stakeholder groups. This has created a neutral and relaxed atmosphere during interview sessions for the participants to discuss their views on not only in favour of PLFRD may happen *but* also discussing their views against it.

Occasionally, there was overlap and repetition of the same views from the different stakeholders. A possible contributing reason was that the data collection was the same time as the DEFRA round table meetings and some of the selected interviews were members of the round table. In this study, the majority part of data collection was focused on the factors influencing stakeholders' decisions between 2010 and 2016. However, the focus of these meetings is on the future horizon for different aspects of properties at risk. Therefore, the influence of the current ongoing discussions on the key stakeholders' views on the possible contributing factors is rather limited. The influence of such discussions on their views about the topic of this study was unavoidable due to the small size of the active stakeholders in the topic under discussion, and the growing opportunities for them to interact. On one hand, in a multi-stakeholder matter such as risk data, this matter is unavoidable as stakeholders are expected to be able to interact and have an influence on one another. On the other hand, this offers the advantage in depth of data as participants are able to reflect on the perception of other actors' motivations and standpoints.

In addition to choosing to focus on specific groups of a wider social group, this research was dependent on the choices of a selection of interview subjects and questions. The overall focus of the study investigated

certain aspects of PLFRD. The selection of aspects was mainly driven by those topics that were pronounced from the stakeholders' point of view in the previous government documents (i.e. DEFRA 2010, DEFRA 2011, EA 2010). In total, 12 aspects were selected to prepare the interview guide to help orient the interviews and to secure sufficient data for the purpose of comparative analysis of participants' views. The overall focus (scope) of the study is to shed light on certain aspects of property level flood risk data debate from the view of certain groups (as referred to this study as key stakeholder groups). Therefore, in choosing to focus on a specific segment of a much wider social phenomenon, it is important to acknowledge that this thesis cannot and does not claim to provide a comprehensive picture of every possible aspect of the property level flood risk data debate from the view of all the engaged stakeholder groups.

Lastly, it is important to acknowledge that the researcher's interpretation, analysis and presentation of the data were a process of (re)construction, which required her to make a variety of choices. These choices were specifically important as they determined the formation of conceptual categories, defining grouping multiple strands of information together to produce a generalised picture of the social word. Therefore, even though the analysis was informed by in-depth interviews, multiple interpretations of the same data are always possible.

5.6 Ethical considerations

In addition to the considerations discussed in the previous section, and the possible empirical constraints they may place on this study, there is an ethical aspect to this research that should be acknowledged. The data collection process in the field was granted full approval by the Research Ethics Committee at Oxford Brookes University. Only adult participants were recruited by email gathered via the public domain (websites of related local government agencies and authorities, and the main private insurers). Community groups (who support individuals in the flooded area) are identified from the media and contacts made in conferences and events. Emails were sent to participants including the reason why they are being contacted and the method of selection is clearly articulated in a covering letter. Letters were included a Participant Information Sheet and Consent Form (See Appendix A and B). Stakeholders participating in the semi-structured interviews were asked to seek consent from supervisors or managers in order to avoid any risks to the participant or the organization. The email and forms outlined the purpose of the research, issues of confidentiality and anonymity. They were also informed about how their interview data would be used in the research.

In particular, due to the unique position of these interviewees, there were asked the question about how they wish their views to be reflected in the study, and whether the direct quotation was acceptable. This was obtained either verbally as recorded during the course of the interview or the signature on the consent form. The level of anonymity for requested by each responder was varied. Whilst some responders consented to be named if directly quoted others asked for their identity to be generalised to that of their company or the title of their responsibility without signposting the organisations. All the interviews were considered as experts' opinions rather than the official views of the organisations unless declared otherwise. This study only quoted those who consented.

After receiving a positive reply to the introductory email, a follow-up was made to agree upon a date, time and location for the interview. Prior to recording the interviews, all interviewees were informed that the conversations would be recorded. Eventually, all the interviews were recorded. Names and positions of participants of the study were de-identified if requested. All the information in the field were encrypted and placed on a password-protected device that was purchased for the study. Additionally, a backup copy of data was periodically uploaded to a secure and password protected online data storage.

5.7 Chapter summary

As discussed in section 4.2, the research follows a qualitative approach. Using the government documents on property level flood risk data, a framework for one-to-one semi-structured interviews with experts/representatives from the key stakeholder groups (i.e. Government, the insurance industry, community support groups) was developed to identify advantages and barriers to the use of property level data in managing flood risk for domestic properties in the UK. The ethical and validation issues that directly relate to the research were also included in this chapter.

In the following chapters, the analysis of these data is presented to address Objective 3 of the study. To avoid repetition and to provide consistency in meeting this research objective, the recommendations are divided into three thematic groups. As demonstrated in Table 5-3, chapters 6 to 8 comprise the analysis of key stakeholders' views on the 12 recommendations that were made in three documents discussed in sections 2.5.

Table 5-3 structure of the analysis chapters

Analysis Chapter	Recommendation
Chapter 6: Data consistency and standardisation	3) Standard risk assessment and survey
	4) Standard damage and claim records for the insurers
	5) EA as the single source of data to understand the impact of risk
	6) Awareness of information sources and data accessibility
	7) Developing a tailored report tool to reflect end users' needs
Chapter 7: Data sharing and communication	8) Data sharing between ABI and the EA and overcoming the relevant legal obstacles
	9) Data sharing between LLFAs and the EA
	10) Enriching EA area based maps with property level information
	11) Risk communication and blight
	12) Licensing arrangements and restrictions on access issues
Chapter 8: Property level resilience measure data	1) Incorporating property level protection data into the insurance underwriting
	2) Proof of PFR effectiveness

The categorisation is based on the key issues addressed in the recommendations, and the commonality factors expressed for the level of implementations by the interviewees. The three groups are; Data consistency and standardisation (recommendations 3, 4, 5, 6 and 7), Data sharing and communication

(recommendations 8, 9, 10, 11 and 12) and property level resilience measure data (recommendations 1 and 2). Each category is analysed separately in chapters 6.7and 8. Eventually, before moving to the final chapter of the thesis, a conclusive summary of the findings is presented.

Chapter 6: Data Consistency and Standardisation

6.1 Introduction

This chapter examines the level of implementation and validity of five recommendations concerning the improvements in the consistency and standardisation of Property Level Flood Risk Data (PLFRD). This includes Recommendations 3 and 4 (standardising data collection in pre and post-flood event), and Recommendations 5, 6 and 7 (consistency in data presentation and dissemination). For each recommendation firstly, a brief background including aim, the proposed actions, and the correspondence action groups is presented. Following that, the level of implementation, current validity and the contributing factors are discussed. The level of implementation for each of the recommendations is reported through four phases including 'Implemented', 'Partially implemented and subject to ongoing development', 'not completely implemented' and 'not taken forward'. Finally, this chapter closes by concluding the most influential factors in improving PLFRD consistency and standardisation.

6.2 Standard risk assessment and survey data

Box 6-1 Recommendation 3

Finalisation and active use of a consistent survey method/template for the survey/loss adjuster and insurance industry; this template should be designed to capture more consistent property level flood risk assessment and post event survey information (DEFRA, 2010, p. 63).

DEFRA 2010 expressed concerns regarding the level of heterogeneity in quality and quantity of Property Level Flood Risk Assessments (PLFRA) produced prior to flood events. It was argued that the inconsistency in data collection for PLFRA hinders data sharing and better use of collected data at the property level. Thus, adopting a flood risk assessment template could bring about a standardised approach. It was also realised that persuading surveyors, loss adjusters and local authorities to adopt a template can be difficult as potential changes in the business process and IT systems of the organisation can be costly. The suggested responsible organisations were the EA, Association of British Insurers (ABI) and individual insurers to promote such template, and loss adjusters and surveyors to implement it. The lead organisation for implementing this recommendation was not clear. DEFRA 2010 also acknowledged that between 2009 and 2010, this issue was being discussed by ABI and the Environment Agency (EA) working group concurrently with the purpose of developing a standard template for property level flood risk assessment. This highlights the significance of this issue at the time.

The interview results suggested three key initiatives in relation to the implementation of Recommendation 3. They include the Flood Risk Report (EA, 2012), Surveying for Property Level Protection (DEFRA, 2015) and the 'Property Flood Resilience database' by the Building Research Establishment.

- **EA Flood Risk Report 2012**

The first initiative relating to this recommendation was the EA (2012) *Flood Risk Report* where a standard template for surveying properties at risk of flooding was proposed by one of the government responders (Interview, Government 1). The template was created by a working group chaired by DEFRA, comprising representatives from a variety of stakeholder groups including ABI, British Insurance Brokers' Association (BIBA), Royal Institution of Chartered Surveyors (RICS), the Law Society, the EA and insurers. The aim was to provide a recognised risk surveying framework for PLFRA, taking into account the existing property level flood protection measures. Flood Risk Report was developed for the use of homeowners, specifically those who had flood protection installed, as a way to advise the buyers or insurers on how the work affected the flood risk. No further updates on how this template was adopted or perceived by stakeholders were mentioned in the literature. However, these interviewees suggested that only the EA occasionally used the template to inform householders on whether their property is flood-resilient, and the level of uptake by the insurance sector was very low (Interview, Government 1; Community representative 3).

Two reasons were suggested for the lack of adoption of such a template. Firstly, both Recommendation 3 and the EA 2012 Flood Risk proposed template failed to provide some form of technical support to advise the integration of collected data into the government organisations or industry's current practice (Interview, Community representative 3). It was not clear how the collected data could or should be integrated with the existing databases and data collection methods, therefore compromising the practicality of the recommendations.

> *The [insurance] companies have never got to use it because apparently, the underwriters do not know how to incorporate that information into the systems that they use (Interview, Government 1).*

Similarly, a government representative suggested that whilst such a template is not suitable for the market where the insurers do not evaluate the existing measures or propose suitable mitigation at the property level as a common practice.

> *Risk assessment for surveyors never really took off in a sense that frequency of that work. So if you are a Chartered surveyor, you are looking at constructions, buildings, conditions, you do evaluation reports. But I do not think that flood work was something that ever attracted them really (Interview, Insurance 3).*

As a result, the template was generally considered inappropriate given current insurance practices and the trend to online policy acquisition (Interview, Government 1).

Secondly, Recommendation 3 and the EA 2012 Flood Risk proposed template failed to specify practical guidance to support where and how and by which authority the collected data would be stored, sorted and used, and the cost of collecting of data should be paid (Interview, Community representative 2). The ambiguity of allocating responsibility throughout the different stages of implementation and perhaps overlooking the complexity and variety of the steps required to make the collected data useful to the end users had a negative effect on the implementation of the EA template. Lastly, the final product was mainly

focused on the use of property owner and was not suited for the use of insurance purchasing market as a key end-user group.

- **DEFRA Surveying for Flood Resilience in Individual Properties, 2015**

Another initiative suggested to be relevant to Recommendation 3 was the Surveying for Flood Resilience in Individual Properties (DEFRA, 2015) to support Government objectives in encouraging the uptake of Property Level Protection (Interview, Government 1; Insurance 3; Insurance 6). The objectives of the project included developing competency specifications for surveyors who assessed flood risk at the property level and mapping the knowledge and skills they require (DEFRA, 2015). As a result, the project designed a surveying training programme entitled 'Surveying for Property Level Protection', to be available at the University of Chester. However, the training course never ran due to the low level of industry interest (Interview, Government 1) and lack of support from both the insurance sector and surveyors/loss adjusters (Interview, Insurance 6).

The main reason contributing to its lack of success, in contrast with the EA 2012 template, was the over-complication of the data collection process. It was suggested that the project coordinator's professional background and expertise in the specific area of flood mapping and flood modelling might have affected the result of the project by placing unnecessary emphasis on some knowledge areas and/or skills such as hydrology and hydrogeology, which was rather unessential (Interview, Insurance 6). Likewise, it was suggested that DEFRA's extensive experience in working with the EA and the local flood authorities at large scale risk assessment levels, obscured their view towards the unique characteristics and requirements of such assessment at the property level. Consequently, in outlining the competencies required for the property level flood risk surveyors, the project suggested a complex blend of skills and knowledge which was described as being excessive and overwhelming to the point it challenged the practicality of the final product. The process of property level flood risk assessment was suggested to be time-consuming and consequently, would significantly increase the cost of assessment (Interview, Insurance 3; Insurance 6).

> *JBA project was on the competence of the flood surveyor and [for that] you have to be a chartered surveyor, and a hydrologist, and the geologist and any other kind of 'ologist' you want to throw in. [therefore] to get somebody to your property with the range of qualifications that that report listed, you have just swallowed your gun instantly (Interview, Insurance 3).*
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> *These sort of things needs a practical application to it, whereas the JBA went into the top end. I think there is a virtue in trying to build something that is perfect but if nobody uses it is pointless (Interview, Insurance 2).*

A key mutual reason that explains the low level of uptake of the EA 2012 and DEFRA 2015 projects seems to be that they both were unsuccessful in incentivising a proper market approach for their products and in proposing a measurable potential income from that product, which resulted in a lack of interest from the surveying and insurance industries. For example, for surveyors, pre-flood risk assessment market is understood to be different from other types of property-level assessments such as a structural survey.

> *There is no reason for the surveyors to do this if there is no market for it. At the moment the market is hugely frozen off in major emergency times which is a short duration and lasts about 6 months to a year. After that, the market will die because there is no demand outside of that (Interview, Government 4).*

There is less and irregular demand as it is geographically restricted to the flood risk areas. Even in those areas, such a service is only provided if either the property owner or the insurer demands it (Interview, Insurance 3). Similarly, due to the obscurity of financial benefits to their business, insurers were hesitant to instigate any changes to their underwriting systems to make them compatible with any new standard template or new information system (Interview, Government 1). One of the obvious challenges of such changes for the insurers was the potential cost of making a change to their underwriting and claim systems and business processes.

> *Insurance is highly automated. The [insurance] companies have never got to use it [the survey template] because apparently, the underwriters do not know how to incorporate that information into the systems that they use (Interview, Government 1).*

This is whilst the benefit of the additional or more detailed data is not clear:

> *For insurers, it would cost more money to having an expert to measure up the house and do a local flow modelling than it would reduce the insurance premium by (Interview, Community representative 2).*

The individual insurers' underwriting systems are often suggested to be highly automated (Interview, Government 1), and many of the big property insurers use dedicated IT systems for processing claims (Interview, Insurance1). Since both suggested incentives failed to establish a profound link with the industry current practices, the cost of such changes was to be burdened by the individual insurers. The barrier created by such additional costs is comparable to the barrier that was predicted to hinder the implementation of such a template in DEFRA 2010.

- **Property Flood Resilience database (PFR-d) 2014-2015**

An industry example of a PLFRA attempt noted was the Property Flood Resilience database project (PFR-d) (Interview, Insurance 3; Insurance 6; Government 1). PFR-d is funded by Innovate UK and conducted by the Building Research Establishment (BRE) in partnership with an association of AXA Insurance and LexisNexis. The aim was to bring together flood risk and flood mitigation measure datasets in a combined database that could facilitate better insurance pricing for properties in flood risk areas. This would also create a systematic process to provide the level of confidence in both the effectiveness of any Property level Flood resilience and Resistance (PFR) measures and the survey itself (Garvin et al., 2016). A prototype database has been developed through an initial review of types of data that are currently collected for PLFRM by surveyors, such as property data, property resilience and resistance measures, and community and local measures. Data such as water entry routes, the condition of building components such as brickwork and any items such as gaps in the frames and other ingress points are included. Data are collected by surveyors who

are certified through the BRE Certified Independent Flood Resilience Surveyor programme (bre.co.uk, 2017). A scoring system was developed to estimate the risk profile of a property based on the collected data.

It is too early in this project to estimate the level of implementation and its level of success in initiating a consistent risk assessment framework amongst insurers and surveyors. However, based on available initial features, a preliminary comparison between PFR-d and the earlier discussed initiatives (i.e. EA Flood Risk Report 2012 and DEFRA Surveying for Flood Resilience in Individual Properties 2015) is discussed in the following paragraphs. This comparison offers further insight specifically into the key factors that influence the level of implementation of a cross-stakeholder harmonised template for collecting property level flood data and generally, into implementing a standard approach to PLRFD activities.

Firstly, unlike Flood Risk Report 2012 and Surveying for Flood Resilience in Individual Properties 2015, which were led by government organisations, PFR-d is led by industry stakeholder groups, including BRE and a member of the insurance industry. This shift in project leaders makes the expectations from PFR-d different from the two earlier projects in three different aspects. Firstly, PFR-d is working closely with some real insurance data. In that light, the PFR-d is more presentable and realistic as a product that could fit with the existing insurance frameworks and systems (Interview, Insurance 3). For instance, in relation to the DEFRA Surveying for Flood Resilience in Individual Properties 2015, one of the insurer representatives noted:

> *They [project conductors] were a consultancy part of the business. They mostly do a very high-end work on big developments, commissioned by the local authorities but not an individual private homeowner. That is a completely different market (Interview, Insurance 3).*

Unlike the conductors of two previous projects discussed earlier, BRE has the experience of undertaking similar property level projects, in the area of energy consumption and thermal protection including Domestic Energy Model and energy certificate (Interview, Insurance 3). He concluded that this gives the PFR-d project a better position in promoting and tailoring the final product to the current needs of the market.

Lastly, unlike the earlier incentives where data collection was done manually, PFR-d data collection is app-based, which is linked to central data storage. It will make consistent data collection easier and faster, therefore more appealing to the market (Interview, Insurance 6). It seems that PFR-d initiatives have addressed the major shortcomings observed in the previous initiative, except for ascertaining a market for PLFRA, which since the project is still ongoing, it seems to be too early to comment on.

However, despite its advantages, this database is for the use of insurers and excludes the property owner. Similar to the previous initiatives this project could fail if the concerns regarding the cost of collecting data are not clearly addressed and its commercial benefit is not specified. A representative from a leading insurance organisation highlighted:

> *I do not see the BRE database to be any different than other property-level databases we buy. It is available and it will be used by people if it makes commercial sense* (Interview, Insurance 3).

The lack of a clear cost-beneficial case for the insurance industry to implement such a recommendation is further pronounced by the absence of support from some form of 'regulatory driver' that enables both the establishment of the framework for such a recommendation and its operational detail. However, DEFRA and DCLG representatives, although agreeing that receiving regulatory backing could promote the issue of lower take-up, discussed that developing new regulations is not the way forward. Firstly because, under the Government Deregulation Act 2015, the UK government is now trying to limit the number of regulations that are put forward and is moving towards reducing the legislative burden for businesses and individuals. A government representative suggested:

> *It's always difficult framing a regulation. For examples how would you frame flooding in building regulations? How could we tell them to make the property is flood resilience when we don't know what's that resilient is ourselves. If you do one regulation we need to get rid of two or three others (Interview, Government 1).*

Secondly, there is a lack of clarity amongst the key stakeholder groups regarding what is wanted from such regulations. A DEFRA representative argued that in the case of property level flooding there are still areas of knowledge to be developed, before even considering framing a regulation. In the absence of sufficient insight into the issue, even with the Government direct involvement through some sort of policy regulatory approach, the success of such recommendations cannot be guaranteed. The example of unsuccessful government intervention at property level policies is the UK Green Deal. It was a government policy affecting the entire UK building stock with the aim to address fuel poverty and reducing the carbon emission in the UK. Based on collected property level data, the scheme provided loans for property owners to improve their energy efficiency and reduce bills. Green Deal was launched in 2013. It was withdrawn in 2015, having achieved only a 1% uptake rate, but costing the taxpayers almost £400m, and achieved little energy or carbon saving and eventually ended up with some energy companies short-changing their customers (Syal, 2016). The interviewee highlighted one of the reasons that the Green Deal failed as follows:

> *We also want to avoid the disaster as the green deal. They thought they've done everything right when they developed it but a few charlatan pilot companies got involved into it… we didn't know enough about what they're doing (Interview, Government 1).*

Acknowledging the Government ambitions in the Green Deal, this interviewee argued that the Government is trying to avoid repeating similar 'disasters'. As a result, it seems that making a sound commercial sense plays a crucial role in whether such incentives will lead to general recognition by the insurance industry and becomes successful. This further highlights the commercial characteristics of flood insurance and the influence it has on the decisions made by individual insurers.

6.2.1 Conclusion of Recommendation 3

Recommendation 3 in this study suggested that the active use of a consistent survey method/template can be beneficial to the insurance industry and promote data sharing between the professional parties. Despite the

initiatives suggested for Recommendations 3, findings of this study suggest that an industry-wide consistent template or framework to collect PLFR information in pre-flood events is still absent. This issue was covered in three different initiatives each adopting slightly different approaches to what was originally recommended in DEFRA 2010. Given the fact that this recommendation has been subject to three different projects in the last five years, one of which is still being developed, this recommendation is considered to potentially remain valid.

Out of the three initiatives that were listed for Recommendation 3, two had very low or no uptake implementation stage. The latest initiative has managed to address some of the deficiencies of the previous similar ones. BRE PFR-d has created clear links to some of the current practices in the market and is benefiting from stronger support from the participants with experience in developing a successful similar project at the property level. The project is still under further development which makes an analysis of the impact of the actions taken to implement the recommendations difficult, and judgment premature. However, the investigation suggests that there is a strong emphasis on 'making commercial sense' as the key factor that determines whether it becomes successful or not. Hence, this recommendation is concluded to be 'partially implemented and subject to ongoing development'. Three key factors were suggested to contribute to the low level implementation of these two initiatives including: (i) lack of cost-benefit justification for the final product, (ii) ambiguity of allocating responsibilities throughout the different stages of implementation, (iii) overlooking the steps of the data processing, and (iv) lack of technical support for integration into current market practice.

6.3 Standard damage and claims record

Box 6-2 Recommendation 4

Finalisation and active use of a consistent survey method/template for the survey/loss adjuster and insurance industry ...Encouragement for the insurance industry to adopt a standard format for the future collection of information relating to household and commercial claims (DEFRA, 2010, p.63).

[For] the ABI and Environment Agency to continue to work together towards sharing flood extent and claims data (DEFRA, 2011b, p.14).

Similar to the previous recommendation and in line with consistent data collection to facilitate PLFRD sharing, in 2010 and 2011, DEFRA set out actions for the insurance industry to develop and adopt a standard method/template in collecting information in post-flood events. The consistent collection of claim information was suggested to facilitate insurers to share such data with other interested parties such as the EA to calibrate and improve official flood risk datasets and the local authorities to better understand the risk. The responsible stakeholder groups for implementing this recommendation were the ABI and the insurance companies in collaboration with the EA.

The level of implementation for Recommendation 4 is discussed from three different points of view. The first two sections represent the general views of the EA and of the insurers respectively who are the two stakeholder groups that were originally assigned to implement Recommendation 4 in DEFRA reports. The third section represents views on the future possibility of implementing this recommendation.

From the EA's point of view, this recommendation was not taken forward since the information collected during claim recording was not suitable to calibrate and improve the Agency's maps. A former member of the EA argued, in contradiction to what has been suggested in DEFRA 2010, that firstly the detailed information of the claims does not fit into the spatial level of their duties, as the EA does not produce property specific flood risk maps (reasons contributing to this are discussed in Section 6.2). Secondly, information collected in the claims process usually comprises information regarding the volume (cost) of the claim, objects and components affected, a number of days the policyholder has been out of the property during the repair process, type of risk, and the cost of reinstatement of the property (Interview, Insurance 3). Such information is either irrelevant or not detailed and accurate enough to be used in the Agency's flood risk prediction and modelling (Interview, Community representative 3). Therefore, from the EA's point of view, this recommendation is not implemented as it does not have validity to the Agency's activities.

Reasons discussed from the insurers' point of view, however, are more complicated. Some interviewees suggested that the need for promoting consistent claims information was perceived as a request from the government with very little benefit to the insurance industry. Insurers collect claims data consistently for themselves as they comprise some key information which is of great value to run a solvent business.

> *In the case of claims obviously, every insurer collects data on that because you need to put it in the next year's renewal policy because that influences the claims. So they gather it but they will not share it beyond individual companies (Interview, Insurance 3).*

The format and level of detail of collected claims vary significantly from one insurance company to another as they are explicitly tailored to fit the company's business plan and risk and in-house claims calculation algorithms. For instance, some insurers, notably the flood specialists, use more detailed data and sophisticated algorithms in comparison to less or non-flood specialist insurers, to provide them with the opportunity to obtain a competitive position in the market. Therefore, having claims data collected and stored in an industry-wide standardised template can put these bigger insurance companies at risk of giving away their competitive advantage (Interview, Insurance 3; Insurance 1; Consultation, Community representative 3).

In an insurance market where the information is asymmetrical between specialised and non-specialised flood risk insurers, any attempts towards harmonising the industry data through an industry-wide standardisation will receive a lot of resistance from the specialised companies. It also can negatively affect the quality of their current practice and in processing their claims and again, reducing their market advantage as an interviewee from the insurance sector expressed concern that:

> *We [individual insurers] tend to get our customers back on their properties before their next door neighbour who is insured by another insurer. We are very strict about trying to join some sort of template approach which might slow us down* (Interview, Insurance 1).

From this point of view, it seems that Recommendation 4 failed to acknowledge industry's views and the possible risks that such templates could have on insurers' market competitiveness and business benefit, particularly of the major flood companies who already have developed a more sophisticated claims procedures with more sophisticated data sets.

Interestingly, despite the issues discussed above and in contrast to what has been discussed as the industry view, a DEFRA representative suggested a more optimistic perspective regarding possible future opportunities for the creation of a harmonised claim data. It was suggested that Flood Re can facilitate harmonised claim data to some extent since under the Flood Re agreement, there is a requirement for the individual insures to provide a database of claims history of those properties they ceded to this programme (Interview, Government 1). An interview with a member of Flood Re in early 2017, suggests that development of this database is still at a primary stage and any judgement of how successful it may become, therefore, is premature.

6.3.1 Conclusion of Recommendation 4

Recommendation 4, similar to Recommendation 3, required the insurance industry including individual insurers, the ABI and the loss adjustors, with the EA cooperation to develop a form of harmonised PLFRD collection. The focus here was on post-flood risk data (claims). There was no evidence of initiatives in addressing this recommendation or the issues concerned in that regards. Consequently, it was decided that Recommendation 4 was not taken forward. The two main reasons suggested in explanation of this situation were first, unlike what was perceived in DEFRA 2010 and DEFRA 2011, the EA does not find access to insurance claim data useful and rather consider the current level of accuracy unsuited for the Agency's mapping and modelling activities. Secondly, similar to the reason discussed for Recommendation 3, the recommendation was understood to overlook the disparate nature of practices of the industry. If the insurance sector joined an industry-wide standard post-flood data collection system, it could jeopardise major flood insurance market opportunities and distort the current market competitiveness.

On one hand from these views, given the issues and lack of follow-ups, the current validity of this recommendation can be questioned. On the other hand, there is still hope towards the development of a form of claims data consistency under Flood Re programme which can be argued as evidence that this topic is not entirely invalid. However, a more detailed investigation of Flood Re's approach suggests that if it is successful, it will produce a harmonised claims database, rather than a harmonised data collection approach for the whole industry. Consequently, this recommendation is concluded as being current invalid.

6.4 EA as the single source of data to realise the impact of risk

Box 6-3 Recommendation 5

We [EA] will develop a dataset that will include information about the sites affected by flooding, including properties… This dataset will be the single source which we will use to understand the impacts of flood and coastal risk (EA, 2010, p. 9).

EA 2010 does not detail how the Agency was planning to take this recommendation forward, at what scale, or who the potential end users might be. The interviewees, who expressed views on the level of implementation of Recommendation 5, had varying perceptions of the level of implementation. The concept of 'one stop shop' was similarly suggested later in DEFRA 2011 as a solution to decrease the perceived confusion of members of the public in gaining information about the 'official' data.

From one point of view, the Recommendation 5 suggestion to create a single source of data following a flood event has been implemented. A government representative suggested its implementation is manifested in an ongoing government project, the Resilience Direct portal (Interview, Government 4). In 2013, a team in the Cabinet Office initiated a secure web-based service project for the use of civil protection participants to assist them during emergency preparation, response and recovery, though not necessary for the use of PLFRM stakeholder groups discussed in this study (ordinancesurvey.co.uk, 2017). This will ultimately produce an online system for collecting and sharing real-time data concerning the level of impact from a variety of risks, including flooding, and act as a secure information-sharing platform for category 1 and 2 of emergency responders at the local level.[6] The platform will facilitate the teams on the ground with a better picture of the event, including information about which communities are at immediate risk and which buildings are most threatened by the flood (Cabinet Office, 2016). Similarly, a major insurance representative argued that such EA databases already exist. He suggests that from a flood insurance experts view, the data the EA incorporated in their flood maps, although still not accurate at the property level, provide a common view at the property level and serve the outlined purpose in Recommendation 5 (Interview, Insurance1). From these views, this recommendation was partially but not precisely, followed up.

Not all the interviewees, however, agreed with that view. Some interviewees commented that not only has Recommendation 5 not been carried out but also that this recommendation is not currently valid (Interview, Community representative 3; Insurance 6). Two reasons were suggested. Firstly, in disagreement with the view of the major insurer representatives mentioned above, it was suggested that although the EA has produced the outline of the previous flood events[7], a database that can feature every property that has been flooded does not exist. The reason for this is that the EA operates at a higher spatial level than property level data, specifically those regarding spatially focused features such as local floods and property flooding (Interview, Community representative 2). Furthermore, although the EA have a strategic overview of all sources of flooding, they are not the lead organisation for flooding from all sources, including surface water and groundwater flooding[8] (Interview, Insurance 6).

> *I think the data that the EA put onto their website does serve that purpose and I think it is a fairly decent map. They give you a common view but at the property level, they are not as accurate as you want them to be. I think the reason is that the EA needs to be operating at the community level, not property level (Interview, Insurance 1).*

Similarly, for groundwater risk, there exist no EA maps showing the affected properties. Such information is more likely to be found partially on the local authority datasets or that of insurance claims. These databases,

[6] As defined by The Civil Contingencies Act 2004, Category 1are the core responders, and Category 2 are known key co-operating responders who are responsible for carrying out the legislation.

[7] Under the Freedom of Information Act, Individuals could use the EA's 'Get the flooding history for a property in England' service to obtain information based on the EA records gov.uk (2017) *Find out if you're at risk of flooding*Available at: https://www.gov.uk/check-flood-risk (Accessed: 20 March 2017)..

[8] The EA have issued a Flood Map for Surface Water in collaboration with LLFAs, who are responsible for managing the risk of flooding from surface water and groundwater. The map represents a probabilistic modelled risk from surface water rather than the affected sites and properties.

however, are either not directly linked to the EA databases, or in the case of claims due to data protection issues, are not shared at all (Interview, Community representative 3).

6.4.1 Conclusion of Recommendation 5

The recommendation regarding developing a single source to realise the impact of flooding on properties was for the EA to implement as a way of presenting a consistent image of risk to all the stakeholders. The interviewees could not determine any initiatives by the EA. It was suggested that a project comparable to this recommendation is being developed by the Cabinet Office. Nevertheless, the suggested project shares information during the emergency period and is specific to a closed group of users. Although it is open to be used by local authorities, it is not open to insurers or the individual homeowners; thus, it will not facilitate consistency and hence sharing of data amongst different stakeholder groups discussed in this research. There was a disagreement between the interviewees on to what extent the current EA maps meet the suggestion made in this recommendation. However the majority of the responses agreed that not only the current EA maps do not provide such information, it is relatively unlikely for the EA to produce such maps in the future. In conclusion, the level of implementation of Recommendation 5 is concluded to be as 'not taken forward'.

Several reasons were suggested to explain the EA's position with regards to this recommendation. It seems that EA 2010, overestimated the extent of the Agency's administrative control over the scale and quantity of collected flood data. In reality, such control is restricted by a variety of factors such as the extent of flood source the EA has direct authority on and lack records on small flood events. Consequently, the current validity of this recommendation to be implemented by the EA is dismissed.

6.5 Awareness of information sources and data accessibility

Box 6-4 Recommendation 6

Action by the Environment Agency to increase the awareness of Environment Agency products and commercially available environmental constraint reports via the internet (DEFRA, 2010, p.67).

DEFRA and the Environment Agency [need] to work together to make flood risk datasets more transparent and accessible (DEFRA, 2011, p.20).

Recommendation 6 concerns the issue of the absence of awareness regarding the available information sources with the goal of increasing accessibility and availability of flood data. DEFRA 2010 suggested that the low level of awareness of existing databases limits the access to such data which can eventually compromise better risk assessment by the professional bodies. It was suggested that the EA should release details of the Agency's data sources (including access, costs and limitations). In 2011, DEFRA Data Provision and Transparency Working Group highlighted a similar issue. It was reported that a wide range of organisations are responsible for flood risk information and the way these data could be accessed is confusing and not always clear. Accordingly, there is a need to increase the awareness of different information services available amongst insurers and the public. Restating the issue mentioned in DEFRA 2010, it was recommended that stakeholders' datasets should be made more transparent and accessible to help the insurers to provide a better service and increase the community awareness of flood risk.

There was a consensus amongst interview participants that, in general, there has been an improvement in the accessibility of data under Open Government Licence (OGL). The general improvements that also partially improved the absence of awareness of existing flood data source were dealt with through UK government Open Source Strategy and Freedom of Information Act (FOI) (Interview, Insurance 3). Following the government Open Source Strategy, the EA started to make much of its spatial data available to the general public through the government website, under the OGL (Flood-warning-information.service.gov.uk., 2017). The EA also publically issued surface water flood risk under the Open Data strategy which was not available previously. The Agency has also provided information and issued individual reports under the FOI if requested. An insurance industry representative added: '*We have got all this stuff that we didn't have before*'(Interview, Insurance 6). Therefore, although the EA has made its data free to use and free to access, for a vast group of users, in the context of this recommendation, the Agency's publically available flood maps and information are not property level specific therefore are not suitable for use in relation to single properties.

A further general change to public information dissemination was that since 2016 all Government body websites, including the EA and their flood information and maps, have moved to 'gov.uk' to simplify the way in which information presented to the public. Although this change was intended to improve the accessibility of information, a government representative expressed concerns that in reality, this has negatively affected the accessibility of the flood maps, as they are no longer available directly through the Agency's web page. He pointed out:

> *The Agency's good stuff has moved under the gov.uk website and it is even harder to dig out. So in a sense, it is now harder to know about and finds that... all the useful stuff from the EA website disappeared to a shadow website'* (Interview, Government 1).

Given these points, it appears secure to note that the current state of the EA map, although improved, does not fully meet the requirements of Recommendation 6.

In addition to the general improvements in representing public data, interviews suggested one more specific initiative specifically related to this recommendation. The Centre for Resilience, launched in 2014, is a research hub developed by the BRE Group with support from Government (Interview, Government 1 and Insurance 6). The aim was to communicate and disseminate flood-related knowledge and draw together relevant advice for the use of property owners (bre.co.uk, 2015). It will provide the property owner with the right source of information before the flood, and signpost people to the right places rather than developing a huge amount of contents of its own. The factor that makes this website different from previously existing similar advisory websites (such as that of local governments) is that during the recovery phase, it would provide a service linked to insurance companies, the builders, and councils (Interview, Government 1). Whether insurance companies and builders provide property owners with information about this website in the future is subject to further negotiations and individual parties' agreement. Therefore, it is too early to comment on the level of success of this initiative.

In the case of a database that could be commercially exploited, a major insurer suggested that there is still an issue of lack of awareness of available data sources for the insurance industry as a whole, although the issue

has not been equally recognised by the major flood insurers (Interview, Insurance 1). In order to make their business profitable, big data holders would make sure that their products are known and used by their customers, i.e. larger insurance companies. From his view:

> '*anybody who has a good source of information relating to this will come and speak to us anyway to make sure that they are making money out of selling it to us' (Interview, Insurance 1).*

However, the majority of information that could be commercially exploited is available to specialised flood insurers, which might not be the case for non-flood specialist members of ABI or the general public. This suggests that the issue of lack of awareness of information sources amongst the key stakeholders is only experienced by some members of these stakeholder groups and do not have a general acknowledgement of being a regular and consistent issue.

6.5.1 Conclusion of Recommendation 6

Recommendation 6 asked for an increase in awareness of existing data sources and better data accessibility for the stakeholders to give a more comprehensive image of the risk. It was suggested that the topic has benefited from the wider government strategy of moving towards Open Data to some extent. However, the flood risk data released under the Open Data strategy is not suitable for understanding the risk to individual properties. Plus, these maps have been moved to the '.gov.uk' which from the perspective of government interviewees' creates further accessibility issues. Initiatives suggested to positively contribute to improving the property level flood risk awareness, was to be the BRE Centre for Resilience hub. The success level of this initiative is undetermined as it is still in the early stages of dissemination.

In summary, there was a consensus amongst the interviewees that such awareness although has been improved, has not been completely met. Therefore, this suggests that the topic has ongoing current validity. The implementation of Recommendation 6, is understood to be partial and subject to ongoing development'.

6.6 Developing a tailored report tool to reflect end users' needs

Box 6-5 Recommendation 7

Development of report tools relating to property level flood risk data which are relevant to the needs of users (DEFRA, 2010, p.60).

As a part of the bigger goal of improving accessibility and use of data using standardised formats, DEFRA 2010 suggested that report tools should be developed to better fit the different needs of the variety of end-users. This action has been noted repeatedly throughout the report, however, it was not made clear who the end users are, or what the expectations of each of the stakeholder groups from such report tools might be. For this reason, during the interviews, participants' views on updates and level of fulfilment regarding this recommendation were led by the interviewees' interpretation of suspected responsible stakeholder groups. With that in mind, the responses were categorised into two groups of government and insurers.

The first group are those who interpreted the government as the responsible stakeholder for creating such reporting tools. In this category, DEFRA and the EA representatives acknowledged different routes on how the proposed action was taken forward. A relevant initiative from DEFRA was the free online calculator *Property Protection Advisor*, commissioned by DEFRA in 2013, currently available on the National Flood Forum website (Interview, Government 1). Bringing together the best practice in property level protection systems, the project developed a calculator that could estimate the cost of property level protection, suitable for use by either individual homeowners or as part of a community scheme (nationalfloodforum.org.uk, 2016). However, although this tool creates some sort of harmony in the reports it generates, the kind of 'consistency' it creates is isolated in a sense that it is not linked to the insurers or the local authorities' databases or recognised by them. This isolation made this online calculator less attractive to the homeowners. It is understood from the literature that this project was not successful for individual property owners, as three years later DEFRA revised the issue and reports *'too often people are unaware of where to go to for advice, the products that exist and the benefits that they can provide'* (DEFRA, 2016b, p. 2). One major insurer, although did not suggest any relative initiatives, expressed that despite the effort of the government, Recommendation 7 has not been successfully implemented (Interview, Insurance 3).

A former member of the EA Open Data Advisory group, not only suggested that this recommendation was not implemented but also rejected the current validity of this recommendation for the government agencies, notably the EA, to implement it. He argued that during 2010 the view was that the EA should develop a portal for whatever the use of general public would be. However, this was made before the EA moved to an Open Data model for flood data in 2014 which effectively solved the issue (Interview, Community representative 3). Most of the previously charged-for data (e.g. NaFRA/RoFRS) is now available to the general public as a free dataset, thus, enabling all the end users to use the Agency's flood data according to their needs.

The second group of responders are those who interpreted the insurance industry as the potential developer of the 'report tools'. From this view, the validity of the recommendation was also rejected. Reasons from insurers were that having such reporting tool could pose some risk to the individual insurance companies by exposing their business data. Individual insurers create a variety of reports, each to suit the specific needs of the company which vary from one company to another.

> *I think wanting consistency makes sense and I do not discount it as being the responsible thing to say but it does not suite all the different companies that are operating… Different individual insurers have a different appetite for risk (Interview, Insurance 2).*
>
> *If you are an independent company creating a report you are doing it in your way you think is right, and to make something that is common across all of them, never had a market appeal to it. So I think it has just died on that basis (Interview, Insurance 3).*

These comments clearly highlight the diversity of approaches and goals amongst the individual insurers. In such a market, having to make some reports different from what they already produce for their customers can result in some bigger insurers to undesirably expose some aspects of their Unique Selling Proposition (USP), which is a factor that differentiates an individual flood insurer from its rivals in the market (Interview,

Insurance 3). Another reason was that as most of the companies' reports are written in a way that is not customer focused, therefore, there is a risk that the information passed to the customers is not what the company wants to deliver openly to their clients and can expose individual insurers to be misjudged by the public (Interview, Insurance 3). Therefore, such reporting tools are perceived as unsuitable as common practice for the industry as a whole.

6.6.1 Conclusion of Recommendation 7

Recommendation 7 suggested tailored reports from the stakeholder groups (however, not specifically stated which stakeholder groups), in line with the goal of increasing the accessibility and availability of PLFRD discussed for Recommendation 6. The result of the interviews suggested different and, in one case, contradictory views on the level of implementation of this recommendation. On one hand, a Government and major insurance interviewees expressed awareness regarding the status of implementation of Recommendation 7. It was argued that this recommendation was implemented by DEFRA's calculator tool which aimed to create an advisory report for homeowners. However, evidence suggests that the calculator does not address the risk and lacks a link to insurance, this initiative was not adopted widely. From the EA's point of view, this recommendation was regarded as partially implemented. Similar to what was discussed for Recommendation 6, this recommendation was partially addressed as a part of the government's bigger strategy Open Data. Albeit, this information is still not appropriate for the use of individual properties. Although the insurance industry representative did not suggest relevant initiatives, it was suggested that despite the government efforts, this recommendation has not been implemented. In conclusion, the status of Recommendation 7 is that it is 'not completely implemented'. The main reason for the lack of complete implementation was suggested to be the loss of the EA's interest in the topic following the FOI and OGL. Additionally, for the insurers, similar to what was discussed for Recommendation 3 (standard risk assessment survey) and Recommendation 4 (standard damage and claim record), such changes to their current practices can jeopardise the market competitiveness of major flood specialist insurers. For the same reasons, the current validity of this recommendation was concluded to be inconsequential.

6.7 Chapter summary and conclusion

Addressing Objective 3 of the research, this chapter presents an insight into the level of implementation of recommendations 3 to 7, their current validity and relative influencing factors that affected their level of uptake. Results are based on the individual insights, offered by the experts. In summary, the need for consistency and standardisation of PLFRD among the key stakeholder groups is still valid but only in relation to two recommendations, namely Recommendation 3: standardising risk assessment survey data, and Recommendation 6: initiatives to increase the awareness of current sources of data. The analysis of different aspects of this topic has demonstrated that standard damage and claims records for the insurance industry, is simply not practical (Recommendations 4 and 5). This is considering the EA as a single source to realise the impact of flood risk at the property level in the current legislation and market setting. In the case of developing consistent reporting tools, the suggested initiatives were understood to have made partial progress by just one of the stakeholder groups. A summary of the main factors contributing to the level of implementation of discussed recommendations is presented in Figure 6-1.

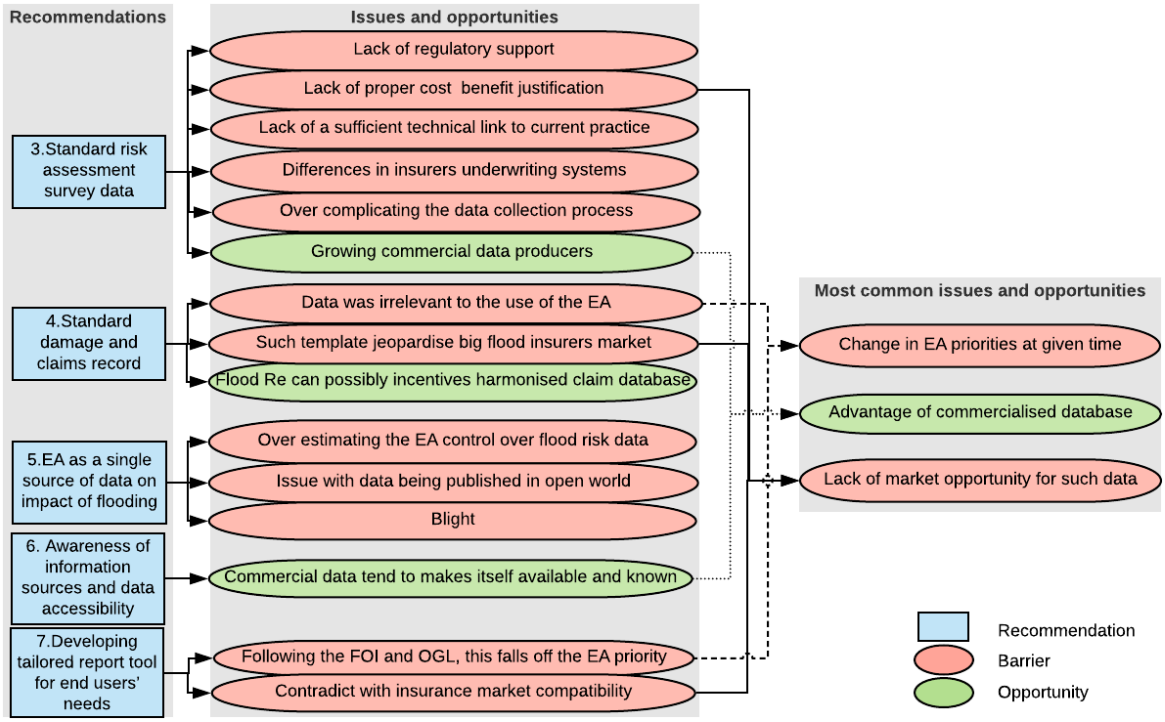

Figure 6-1 Summary of the key factors contributing to the level of implementation of recommendations concerning data consistency and standardisation

Two key common barriers are drawn from analysing the factors affecting the level of implementation of recommendations 3 to 7. Firstly, recommendations were often based on the assumption that there is some degree of willingness to share data (both to grant their data and to make use of receive) amongst the engaged stakeholders. The findings of this chapter suggest that although in theory such claim can be justified, in practice this willingness is very small. Secondly, these recommendations had the EA as the key player in the implementation of PLFRD consistency and standardisation. This was on the basis that the EA is the primary public body responsible for flood protection in England, and one of the biggest providers of national flood risk assessment products in England. Despite this emphasis, there is limited evidence of the EA's leadership in the suggested initiatives. Findings suggested that the actions associated with the EA's role were mainly fulfilled under the government's approach towards data openness such as Freedom of Information Act. This does not satisfy the need for PLFRD as suggested in the associated recommendations. From the researcher's perspective, the EA's performance in regard to PLFRD was an unsurprising result and concurs with their legal role. Although preferably, analysing the stakeholders should be done prior to starting the participatory process, it should be seen as a dynamic process since the nature of stakeholders' views, requirements and interests at various phases can change (Reed et al., 2009). The EA is required to perform at the regional and local scale. Their priority is to focus on ensuring that the flood defences are built in the right areas and protecting larger numbers of homes rather than dealing with individual dwellings. Consequently, the data analysis suggested that PLFRD holds a less recognised position in the EA's priorities despite the emphasis that was placed on it in DEFRA 2010 and DEFRA 2011.

This marks one of the key patterns in the findings of this study which will be developed further when this pattern re-emerges in the upcoming chapters.

Linking risk of collaboration with its benefits for each actor is of the conditions that contribute to its success Bouwen and Taillieu (2004). Here, a key implication of the findings in this chapter is the lack of business opportunity for the insurance industry in the suggested initiatives. This issue is evident in Recommendation 3, 4 and 5. Whilst DEFRA 2010 and DEFRA 2011 suggest some broad theoretical benefits to insurers through harmonised PLFRD, the financial cost of data collection and making changes to the current practice is unavoidable. However, the subsequent benefits of such changes for the business sector are still unclear and not convincing. This issue subsequently, affects the insurance market for products that support such standardisations and consistency in data.

In conclusion, despite the current situation with the EA's lack of interest in taking leadership of the PLFRD and the unclear benefit of the insurance industry as discussed before, there is still hope that the data consistency will be improved through independent and commercial data providers which are credited with fairly consistent views of the flood. In the next chapter, the analysis of recommendations is continued.

Chapter 7: Data Sharing and Communication

7.1 Introduction

To achieve Objective 3 of the study, continuing from the analysis of the first group of recommendations this chapter presents the outcomes of the analysis of the second group of recommendations with more focus on the enhancement of data characteristics and wider disclosure of property flood risk data. This category comprises five recommendations including: Recommendation 8 (ABI sharing data with the EA), Recommendation 9 (Data sharing between LLFAs and EA), Recommendation 10 (Enriching EA area based maps with property level information), Recommendation 11 (Risk communication and blight) and Recommendation 12 (Licensing arrangements and restrictions on access).

In sections 7.2 to 7.6, the level of implementation and validity of each recommendation is evaluated, and associated contributing factors are analysed. Following the pattern adopted in the previous chapter, four levels of implementation are used to describe the extent of fulfilment for each recommendation. They include: 'Implemented', 'Partially implemented and subject to ongoing development, 'Not completely implemented' and 'Not taken forward'.

7.2 ABI sharing data with the EA

Box 7-1 Recommendation 8

Security controlled supply of claims data between the insurance industry and Government departments (Environment Agency) (DEFRA, 2011b, p.66).

In 2011, Department for Environment, Food and Rural Affairs (DEFRA) Data Provision and Transparency Working Group proposed that flood extent data and claims held by insurers should be shared with the Environment Agency (EA) to be used to improve and calibrate the EA flood risk models. It was also suggested that such data can assist better targeting of individual properties for the purpose of flood warning and promote property level protection measures. Hence, it was recommended that the EA and the Association of British Insurers (ABI) investigate the feasibility sharing such data between themselves. Interviews and consultations with government and insurance industry representatives indicate that the ABI does not share individual property claims data with the EA. Reasons why this recommendation was not taken forward, are suggested to be as follows.

i. ABI does not possess detailed property level data

The first reason why Recommendation 8 was not implemented was simply noted by one major insurer to be that the ABI does not have such detailed data as the individual insurers only provide ABI with general statistics rather than detailed information about their claims (Interview, Insurance 3; Consultation, Insurance 7). The role of the ABI is often explained as '*a club of insurers'* rather than '*telling insurers what to do'* (Interview, Insurance 6). Similarly a major insures noted that:

> *A lot of insurers are fiercely protective of their own data, so actually what they give ABI is very limited. That is another link in the chain which is difficult to move (Interview, Insurance 3).*

Not only does ABI have limited detailed data, but the rights to the data that they possess are also limited. Most of the insurers are fiercely protective of their own data which further restricts ABI's authority in sharing information. Individual insurers cautiously examine what their data is being used for and its security (Interview, Insurance 3). It was argued that there cannot be much reliance on ABI since their role is limited and there is a potential conflict of interest as they are representing the whole insurance industry (Interview, Insurance 3; Insurance 6). ABI's data is based on their members' data, not on their own, therefore, any action regarding sharing the members' data should seek the consent of all the members. Obtaining such consents is likely to be extremely challenging, given the fact that ABI has over 250 member companies, which account for over 90% of the UK insurance market.

ii. Data privacy

Another issue with regards to sharing claims data revolves around data privacy (Interview, Insurance 2). Similarly, a community representative highlighted:

> *The insurance industry as a whole though has been against of mass scale sharing of property level data because they regard it as a potential privacy invasion ((Interview, Community representative 3).*

Under Data Protection Act 1998, unless there are consent and compliance with legal obligations, it is prohibited to process personal information including any data related to a living individual that can lead to identifying them e.g. full postcode and financial information. Individual insurance companies are required to comply with the UK Data Protection Act 1998 which is a barrier to sharing of personal information when dealing with claims data or flood extent information (Linklaters.com, 2012).

iii. Lack of commercial benefit and a possible threat to market competitiveness

As with the issue of implementing data consistency and standardisation discussed in Chapter 5, the interviews suggested that a lack of clear and convincing commercial benefit for individual insurers was a major barrier to the sharing of insurers' flood extent and claims data with the EA (Interview, Government 1; Community representative 3). A major insurer noted that:

> *We [individual insurers] have to act for the common good…but we do not give away our commercial value as we are not a charity and we need to make a profit for our shareholders* (Interview, Insurance 1).

Maintaining market competitiveness was one of the most repeated concerns amongst the insurance industry representatives. It is clear that individual insurers use data to assess risk and price it accordingly, therefore, competition on providing faster and cheaper insurance products forms an important part of their agenda, making their risk assessment data commercially sensitive. It was suggested that individual insurers treat data as their intellectual property and their competitive advantage. For example, two major insurers suggested:

> *Data is what help insurers to understand [the risk] better, and get ahead of the competition* (Interview, Insurance 1).
>
> *The ABI members would not be prepared to share data because it is their competitive advantage (Interview, Insurance 2).*
>
> *I imagine that it (this recommendation) would have been restricted and not happened because the ABI members would not be prepared to share data, because it is their kind of USB or their intellectual property and their competitive advantage (Interview, Insurance 3).*
>
> *Currently, there is no mention of data sharing in the roundtable meeting at all in any of the meetings I have been to since. There is a worry that they lose market share if it is revealed how they manage their flood risk* (Interview, Insurance 6).

The interviewees often address insurance data as their competitive advantage and their trade's secret. By sharing their risk data, the individual insurers' portfolio and how they manage their flood claims is revealed which can lead to the identification of business strategies. Hence, any agreements between insurers to harmonise sharing data use, if leading to influence premium settings, are likely to raise competition concerns as it reveals how they manage their flood claims, and eventually, it can negatively affect their market share. The European Union (2010) argues that sharing strategic data such as customer data can increase transparency and therefore, negatively affect firms' incentives for competition. UK competition law similarly prohibits agreements and arrangements which can prevent, restrict or distort the rivalry between business entities (Competition Act, 1998). Therefore, in the absence of motives and evidence for instigating financial benefit, for example, through increasing their market share or assisting with building a brand, the insurance data-sharing would not be possible.

iv. Insurers claim data is unsuitable for the EA use

In addition to the issues discussed above, the current validity of this recommendation was questioned by one of the representatives from the insurance industry. It was suggested that following a major flood event the Agency collect flood extent information whereas the insurers do not gather such information unless the owners of flooded properties make a claim.

> *To my best knowledge, we have never been asked for the data [by the EA]. In terms of understanding what the extent [of a flood] is, the EA are flying drones over the flooded areas so they get that data anyway. We can only infer the extent by whether the property we insured got floods or not (Interview, Insurance 1).*

Therefore, the EA databases on flood extent are more sophisticated to data individual insurers can offer. Moreover, this interviewee suggested that the insurance data does not necessarily display where the floodwater has spread because they are not present at the event and therefore cannot add any further information to what the Agency already have.

v. The opportunity of Flood Re

Looking into the future, a government representative was optimistic about future detail data sharing. Firstly, a flood surveyor representative has observed that there is more openness from the major insurance companies to the idea of sharing more data (Interview, Insurance 6). Secondly, there is a strong possibility in Flood Re to share data they own with a third party (Interview, Government 1). Flood Re requires individual insurers to share details of claims they ceded to the scheme. In its first transition plan, one of Flood Re's goals is to ensure that their data are used to their full potential. This is achieved by considering possible opportunities for sharing data on flood risk and costs with a wide range of stakeholders e.g. EA, local authorities and the insurance industry to assist them with risk management decisions. The level of detail that can be made public is subject to further negotiations.

7.2.1 Conclusion of Recommendation 8

In 2011, DEFRA suggested that detailed insurance data can assist the EA by delivering better mapping and tailored flood risk warnings; therefore, ABI and insurance companies should consider sharing non-sensitive information. The analysis of interviews suggested that this recommendation was not taken forward for several reasons. Firstly, not only does the ABI not possess detailed claim data to share with the EA but the data they possess originate from their members, many of whom are unwilling to share due to data protection concerns and lack of clear commercial benefit. Moreover, there was a view that detailed data held by the individual insurers for the claims process does not necessarily offer an improved view of flood extent to the EA.

There was a common view between both the insurers and the government representatives that data sharing, in the way that was suggested in Recommendation 8, would be unlikely to happen in the near future in the framework that was suggested in this recommendation. This suggests that whilst this recommendation holds low validity, with some modifications, the possibility for detailed data sharing exists under the Flood Re scheme.

7.3 Data sharing between LLFAs and the EA

Box 7-2 Recommendation 9

Encouragement of local authorities to supply details of the location of previously flooded properties to the Environment Agency (DEFRA, 2010, p.66).

DEFRA 2010 argued that using information held by local authorities will improve the assessment of future FRM actions and/or assist the development of enhanced flood risk models. Therefore, it was recommended that the local authorities should improve the sharing of flood risk information at the property level with the EA. DEFRA 2010 predicted such data sharing could encounter three possible issues: (i) a large number of local authorities involved and the variety of format/quality of existing data each of them holds; (ii) the limited resources in the local authority to collect and provide new data for other parties, and (iii) the potential issue of blight.

Following the Freedom of Information Act (FOI) and the Flood and Water Management Act 2010 (FWMA), there have been some improvements in data sharing between the EA and the local government. A

government representative reports that sharing the name and address of flooded people from the local authority is not an issue any more (Interview, Government 1) as it can be shared with the EA in specific occasions such as when applying for an EA property level flood protection schemes. Additionally, it was suggested that information about the outlines of a flood event and what has been affected by a flood event is discussed with the EA in the regular meetings that they have with LLFAs (Interview, Government 5; Government 6). However, the interviews and consultation with the LLFAs suggested that sharing detailed property level data with the Agency is not common practice. An Issue hindering LLFAs from collecting harmonised property level data and sharing it with the EA was that the detailed property level flood risk information is not recorded by local authorities on a regular basis. Instead, it is done for specific purposes such as to calculate the cost and the benefit of a project when applying for different flood-related schemes (Interview, Government 6). However, even in doing so, local authorities cannot always provide the necessary measures due to the limitations in the number of staff and budget.

> *Local authorities gather information about where things are, they do not do flood risk modelling since they do not have the manpower expertise, computing or money to do it. they may do some local level flood risk modelling where there is going to be a new housing estate development* (Interview, Community representative 2).

It was suggested that following the government budget cuts for flood risk management, local authority flood risk teams are reducing in size. In response to that LLFAs have to scale back their flood reports to fit within the budget (Interview, Government 5). Consequently, similar to the issue discussed for Recommendation 8, data collected by the local authority is not suitable for EA mapping and modelling, as EA modelling requires a high level of precision that can only be achieved through exact measuring and is far too detailed in comparison to data collected by local authorities. Local authorities cannot themselves conduct flood modelling or risk assessment since they do not have the manpower, expertise, computing power nor the budget to do so (Interview, Community representative 3). Another local government representative added:

> *The EA has a better database than we [local authorities] do. So they would know more than what we would* (Interview, Government 5).

Another issue discussed was the households' apprehension of misusing that data. Property owners often are reluctant to share data if they think there is a chance that their information is shared with the local government or the insurers due to its possible negative effect on their cost of insurance or the sale of their property. Interviews suggest that homeowners are still concerned that detailed data in the public domain could signpost properties at risk and cause blight and affect their insurability. One major insurer noted that:

> *I know some people do not want to go to Flood Re because they think that would identify their properties as being at risk of flooding* (Interview, Insurance 3).

A community representative added:

> *Many people come to us [community flood action group] with the concern about where this data [that NFF collects] is going, who would be able to see it… they don't want the EA to have data related to their properties. They don't want the councils to have it because they might not get insurance and might not sell their house* (Interview, Community representative 3).

The effect of such perception amongst the homeowner is to the extent that can negatively affect the data they share with local authorities. This community representative suggested that the local statistics that are based on data collected from flooded individuals might not reflect the real picture of the event since the information the homeowners give the EA or the councils is sometimes incomplete or even incorrect. This suggests that the concern that the detailed information can lead to blight, as suggested in DEFRA 2010, still exists amongst the general public. Homeowners' concerns regarding the negative financial impact of flooding on the property value, saleability and insurance have also been acknowledged in the interviews, although it may not reflect the market reality (Lamond, Proverbs and Hammond, 2010; Small, Newby and Clarkson, 2013; Joseph, Proverbs and Lamond, 2015).

7.3.1 Conclusion of Recommendation 9

Result of investigating the current state of LLFAs sharing PLFRD with the EA suggested that PLFRD is shared with the EA on some specific occasions, such as funding applications; however, it is not a common practice. Although there has been a noticeable improvement in the level of data sharing between the government and the local authorities following the recent changes in the government approach towards data openness, this does not include the detailed exchange of data at the property level. Therefore, Recommendation 9 is regarded as not completely implemented.

Possible explanations for this level of implementation include insufficient local government resources for detailed data collection and the possible issue of blight. In addition to these barriers, some government representatives questioned the suitability of the data collected by the local authorities for the use of the EA flood mapping and modelling which disregards the validity of this recommendation.

7.4 Enriching EA area based maps with property level information

Box 7-3 Recommendation 10

A greater range of the impacts of flooding and coastal erosion, and the risk of flooding to a property level, will be considered… We [the EA] will assess whether we should now be mapping to that [property level] scale … Investigate whether we [the Environment Agency] can realistically assess risk to the property level in a cost-effective way, and if so, determine whether we need to take a risk-based approach to the application of that method (EA,2010, p.9).

The EA 2010, (i.e. the Flood and Coastal Risk management Risk Mapping Strategy 2010-2015 (FCRM)), the EA stated that the Agency finds it difficult to communicate with the general public the variety of information that is provided within the range of their flood maps. It was argued that property owners often seek information about flood risk to their houses, and when looking at the EA maps they misjudge the information as already being property specific (EA, 2010). Therefore, homeowners fail to make an appropriate decision to mitigate the risk. In addressing this issue, under Principle 4 of the FCRM 2010-2015, the EA proposed that as

an alternative for the area based flood risk maps, the Agency would assess the feasibility of creating realistic and cost-effective flood risk maps at the property level.

As the EA clearly states when describing their current publicly available flood risk maps, that they are not suitable for a single point i.e. for an individual property (see section 3.2.3). This suggests that the EA has not published the dataset that was described in FCRM 2010-2015. The interviewees also agreed that this recommendation has not been implemented.

The main contributing reason for Recommendation 10 not being taken forwards was suggested by a former member of the EA to be the alteration of the EA perception in regard to developing property level flood risk maps.

> *Back in early 2010, the general thinking was that a greater granularity flood risk map at the level of the individual property was technically possible, and when combined with further property level information, could give a 'true picture' of the risk and therefore, valuable for a various range of stakeholders including the insurers. Nevertheless, as time goes by, that thinking changed* (Interview, Community representative 3).

Reasons contributing to the change of EA perception can be explained through a combination of several factors as discussed in the following.

7.4.1 Battle of costs and priority of responsibilities

The first issue argued was that the Agency does not necessarily have enough information to add to their flood risk modelling. The cost of collecting the appropriate amount of details to ascertain the influencing parameters accurately comprises a big financial investment for the EA. A former member of the EA also noted that any flood defence micro level risk assessment, which was believed '*to some extent is at property level'* is still regarded as highly expensive and not cost effective at the national level (Interview, Community representative 3).

The concern of cost was also evident in different government reports. During 2008 and 2009, the EA reported that the cost of having detailed property level flood risk surveys was estimated between £28 and £32 per property at 2008 prices which included the attributed cost to establish relevant property characteristics such as the level of the property thresholds such as the level if doors and air vents (EA, 2008). Consequently, it would cost the EA between 9 and 12 million pounds just to conduct a detailed survey of all 49,000 properties at significant risk of fluvial and coastal flooding in England. In 2012, DEFRA estimated the cost of risk assessment cost between £400 and £500 per dwelling (DEFRA 2012). In 2015, DEFRA suggested that the cost of such activity was reported by local authorities to be as high as between £300 (for a flat or maisonette) to £1000 (for a bungalow or detached house) (DEFRA, 2015). In the same report, the EA estimated a rise in the average survey fee of between £400 and £500 per property comparing to 2008 price.

At the national level, such activities would not be cost effective for the Agency. Based on their legal framework of responsibilities, the EA is responsible for national flood risk management and providing data and tools for higher levels of risk management such as providing evidence and support for policy decisions. A DEFRA policy advisor noted that:

> *Individual householders are responsible for flood management of their property. It is not the government's responsibility. We [the government] are responsible for protecting areas and that's what we do* (Interview, Government 1).

Therefore, as most interviewees acknowledged, this responsibility does not include a legal role or duty to protect individual properties in general, nor to develop data that is required at such levels. In addition, an indication of this responsibility framework is that, as such micro-level activities are not the Agency's designated role, thus, they are not allocated a specific budget to undertake such actions. As a consequence, if they wish to proceed with developing PLFRD, or similar property level engagements, the cost would be borne within the economics for the flood-defence schemes. The EA should justify their expenditures of public money, on the basis of bringing the most benefit to a larger number of taxpayers.

> *But what I know is that like a number of government departments Defra and the EA are dealing with large budget cuts. That is their biggest change. Should they spend their money on capital expenditure, e.g. building flood schemes and maintaining them or should they spend that money to build a computer system to give them a more granular view of flood risk. they should decide which can make more benefit to taxpayers (Interview, Community representative 3).*

As a result of these circumstances, a former member of the EA suggested that the Agency selects to spend the public money on flood structures so that a larger number of people can benefit from it rather than spending the same budget to obtain a more granular view of flood risk which then can be used by the individuals (Interview, Government 1; Government 5; Community representative 3; Insurance 3). Given the significant financial investment required for developing such detailed datasets, such expenditure is not easily justifiable within the government since the benefit of such information will be to a limited number of individuals (taxpayers) whereas flood-defence schemes would benefit a larger number of people.

7.4.2 Uncertainties in flood prediction models and public misconception of data

Although in recent years there has been a significant improvement to the accuracy and quality of the EA maps, a lot of information presented in these maps are simply modelled data (Interview, Government 1) and therefore, are prone to multiple sources of uncertainty that the Agency does not, and probably cannot, capture. A major flood insurer suggested that neither the Agency nor the insurers have data going back long enough to be able to calibrate precise flood return periods. Consequently, for example, the 1 in 100 return periods only represent the relative risk; help the user to understand that 1 in 100 is less risky than 1 in 50 years (Interview, Insurance 1).

Another source of uncertainty was suggested to be that the local level of flooding is on many occasions affected by very specific local factors that are expensive and time-consuming to model, and often challenging to track. For example, the EA cannot signify, on a given day, how much weed or clogging is in the river or whether farmers have cut back vegetation in the ditches (Interview, Government 1). '*It is also not easy to keep track of whether the local budget for maintenance has been put to work effectively'* (Interview, Community representative 2) and how these factors affect the hazard at the property level. Similarly, it is not possible to know about the features that appear in the ditches. It was described that in a flood incident, an old

ladder appeared in a ditch and blocked the culvert under a road where water from a big ditch flowed through. Hence, the water didn't follow the culvert and broke out of the ditch and flowed across the field into the houses (Interview, Community representative 2). Additionally, unpredictable human activities can also alter the risk at a property level considerably. For example, during 2007 flood in Berkshire, a community representative described that a garden gate was left open and it altered the direction of flow and the nature of the buildup of the flow on the day. Consequently, as the water reached a particular panel fence, it flowed through the panel fence in an unexpected rush and caused flooding in particular places. He noted that if that garden gate has been shut, the water would have gone a different way.

As demonstrated in the above examples, moving to greater granularity maps conveys a great level of uncertainties. No amount of modelling can successfully predict the random features appearing in the water pathway or the effect of the property owner actions, hence, no property level flood risk model can exist without a large number of caveats and degree of error. A community representative explained:

> *It's a little bit like the Heisenberg uncertainty principle in physics and consequently the butterfly effect in Chaos Theory… There are going to be things that you don't know, that you miss, which means that your model may be wrong. It may be wrong without you knowing it* (Interview, Community representative 3).

Therefore, as the Agency does not have such data, if they published a very granular deterministic flood risk map it is highly likely to be inaccurate. Communicating such uncertainty to the general public, through the means of mathematical data (e.g. percentage of accuracy) is problematic, as the general public has a literal interpretation of such data, and the type of decisions informed by them varies significantly (Interview, Government 1). Further to that, should such a detailed map become generally available, there is a risk that the data would be misused and misinterpreted. It could be misused since, for instance, there are companies that sell domestic property protection mechanisms. Further to that, a former member of the EA discounted the chance of such a database being developed by the EA in the future. He warned that having such databases available, can create the risk of some groups using the statistics to their advantage and consequently since the general population does not understand statistics and error bars, an uninitiated homeowner may be misled as '*they do not know any better*'. He added: '*there are sharks out there when it comes to the domestic level resilience mechanism'* (Interview, Community representative 3).

Similarly, there is a risk of public veracity and misinterpretation of data. He warned that the general public tends to ignore the caveats in flood risk maps. A former member of the EA suggested:

> *When it [EA flood map] says a house is in a certain colour square of risk it will be received by the public as an absolute gospel truth that is the flood risk to my property* (Interview, Community representative 2).

The property owner would place a great degree of veracity on such data. Even if the caveat is explained, there is a good chance that it will be overlooked by the general public. For example:

> *The caveat might say: warning, this data might be wrong because there is some stuff that we didn't know about when we built the model'. That caveat will get ignored [by the general public]* (Interview, Community representative 2).

Therefore, given the existing level of uncertainty of the property level flood risk assessment, if the EA published property level flood risk maps on open data environment, it could cause issues as discussed; it may either cause homeowners to sit at home under the false belief of safety, or to overreact and lead to excessive and unnecessary actions and expenses. Thus, any property level information can be adopted literally and lead to property devaluation and blight regardless of the level affected. The issue of blight is discussed in more detail in section 7.5.1 in this chapter.

7.4.3 Conclusion of Recommendation 10

In this section, the recommendation regarding the development of property level flood risk map was investigated. Corresponding to the findings from the literature, the interviews did not specify any EA initiatives in relation to Recommendation 10. It is therefore concluded that this recommendation has not been taken forward.

This level of implementation was the result of two factors. Firstly, collecting more detailed data is costly for the Agency. As this action do not have a significant place in the EA regulatory roles and spatial level of operation, this cost is rather unjustifiable. Secondly, at a micro level such as individual property, the high level of uncertainty that exists in modelling flood maps can create large error bars in risk assessment results. These error bars are often overlooked by the homeowners at risk, which can lead to a household's inappropriate reaction.

7.5 Risk communication and blight

Box 7-4 Recommendation 11

Education is required to inform property owners of solutions to minimise the impact of flood events… Solutions and benefits should be communicated in plain English and case studies of success stories presented showing how measures can be funded (and associated costs) … Information on flood risk should form part of information provided by developers with new property in flood risk areas (DEFRA, 2010, p.45).

DEFRA 2010 suggested that amongst data owners there is a concern about property blight caused by revealing the risk of flood to a property. As a consequence, there was a perceived risk that property owners would be deterred from reporting incidents and communicating risk-related information. Due to the same issue, some organisations with the ownership of primary data that were in direct contact with flooded individuals and communities refused to disclose data. This document suggested that although studies at the time suggested that, within the current data disclosure regime, the chance of blight to properties at risk is small, there exists a perception that property level flood information could be used by some organisations, specifically the insurers, to increase the cost of the insurance. In extreme cases, devaluation of the property and effects on its saleability were the matters of concern. To overcome this issue, DEFRA 2010 suggested that property owners should be informed of the risk and be educated about the possible solutions that could

assist to minimise the impact of flood risk. The suggested lead organisations to implement these recommendations were listed as the ABI, the EA, Local Government Association and the National Flood Forum (NFF) (DEFRA 2010).

The issue of perceived blight was not only suggested as a barrier that influenced the implementation of this recommendation but it was also an issue in Recommendation 5 (EA as a single source to realise impact) and Recommendation 9 (Data sharing between LLFAs). In the following two sections, first, the stakeholders' views on the topic of blight and the effect of property level flood risk data are analysed. Then, initiatives suggested regarding Recommendation 11 are discussed.

7.5.1 Blight: risk of the government issuing PLFRD

Empirical studies suggest that in the current data disclosure regime, blight is unlikely the value of the affected house is often restored following its reinstatement after flooding. Insurability is also rarely affected. DEFRA 2010 similarly acknowledged that under the current disclosure regimes, the majority of the flooded homes or those at risk are not negatively affected by property values or sales. Several studies support this view. For instance, Lamond, Proverbs and Hammond's (2010) study on the effect of the publication of the EA floodplain maps and flood risk data on the price of domestic properties in the UK during the 2000 flood and suggested that the effect of the flood on the value and saleability of the houses was small. It was also suggested that this effect is highly sensitive to change in market conditions and the frequency of the risk. A more recent study on property value during three major flood events between 2002 and 2012 in Tewkesbury and Cockermouth suggest the same results. Similarly, based on Zoopla database on property value between 2002 and 2012 (Barford, 2012), 2005, 2007 and 2009 floods did not have a significant long-term effect on the price of the houses in the affected areas. Rather during this period, the fluctuations of property value in these areas followed the general trend of residential property values of the rest of England.

The interviews suggested that the current state of flood risk data dissemination does not raise concerns regarding the issue of property blight. This is mainly due to the fact that the general public does not often have a realistic interpretation of publically available data sources and their responsibility towards protecting their properties (Recommendations 5 and 10).

> *It is advised against enabling people to zoom in too much, such you can see a view of an individual house and where it fits in a given a square of risk level… because they believe that when the map says the house is in a certain colour square of risk it will be received by the public as absolute gospel truth, and that is the flood risk from my property (Interview, Community representative 3).*
>
> *Although the EA flood maps are readily available to the public, in the real world normal people who do not understand flood risk properly will not check the maps (Interview, Insurance 1).*

Up until the Flood Re agreement, the SoP agreements secured insurance covers regardless of their risk. This had a discouraging effect on property owners to take actions to reduce risk by protecting all properties irrespective of their risk levels (Kunreuther and Pauly, 2006; Lamond and Penning-Rowsell, 2014). It can be

argued that the legacy of those agreements was homeowners' lack of confidence to engage in property level flood risk management, either because the homeowners do not know about their share of responsibility in protecting properties or do not know how to mitigate their risk.

Similarly, it was suggested that the term 'flood risk' does not have a major effect on the final decision of many buyers. This is because they have never experienced a flood event before, hence they do not have a realistic view of what flood risk is.

> *From the house buyer view, although more information on the flood is available compared to before it doesn't mean that the buyers are more aware of the risk. Firstly, because a very small number of people get flood surveys done prior to buying a house, the problem is more about the [lack of proper] education. Secondly, even if they go to the EA maps, it is not a sensible place to go other than a general overview of some types of flood risks (Interview, Insurance 6).*

This can be due to the reason that the currently publically available flood risk maps and data, such as return periods, are not comprehensible to the general public (Interview, Insurance 1; Community representative 3; Government 1), and therefore, do not *'really'* affect their decisions in buying a house. Secondly, the general public often has a more real understanding of other property-level risks such as burglary or fire. Most house buyers do not have a realistic view of flood risk (Interview, Insurance 6; Insurance 1; Community Representative 3) and its consequences and '*do not know what flood fear is'* (Interview, Insurance 1).

> *They think it doesn't matter because they believe it would not flood and they buy the property (Interview, Government 1).*

A major insurer suggested that '*everyone at some point has been broken into or know someone who has*' (Interview, Insurance 2), consequently they can relate better to the image of such risks and their possible consequences, whereas, the risk of flood is rare and limited to specific locations.

Another characteristic of a house at flood risk area is that it usually benefits from attractive sceneries and sometimes a river view. This highlights another important factor of the location which counteracts the disincentive to purchase a house at risk of flooding (Interview, Community representative 3). An insurer interviewee added:

> *What happens at the moment is that people look for a property, find a property and typically a property by a river looks brilliant. They go and look at the property fall in love with it and go through the buying process* (Interview, Insurance 1).

The effect of this factor on the buyers' final decision is similarly supported by empirical studies such as Bin et al. (2008), Speyrer and Ragas (1991) and Eves (2004).

The timing of presenting the information regarding the possible risk of flood and the history of flooding is another key factor. For instance, it can affect the potential buyer's decision depending on when such data is obtained within the process of buying a house. At the moment, flood risk data is not provided at the early stages of property selling/purchasing point. Although the EA flood maps are readily available to the public, generally, buyers do not check the maps prior to the property transfer and a very small number of people get

a flood survey done before buying a house. Consequently, they only become well aware of the risk at the final stage of property transfer and the buying process. By that time, as suggested, the prospective buyers are so in love with the house they do not want the deal to halt (Interview, Insurance 1; Community representative 3). This effect was also observed by Donnelly (1989).

In summary, there was a consensus amongst representatives from all three stakeholder groups that, as similarly stated in DEFRA 2010, in the current data disclosure regime, the risk of blight in the property market is insignificant. However, they were concerned that any change regarding the aforementioned factors can lead to signposting the individual houses at risk and can cause blight or affect the sale and value of these houses.

> *If at the estate agent point, we flag the properties as red, amber or green then most people would not even look at red properties and never have the chance to fall in love with it. So I think there will be a real issue with selling a property in that flood area* (Interview, Insurance 1).

In conclusion, the issue of blight is not a current issue, but could still pose risk in the future. Findings suggested limited evidence to explain the relation between blight and the current level of flood risk data. However, it is expected to be a barrier if it is ever decided to publish detailed property level flood risk data.

7.5.2 Suggested relative initiatives

A suggested initiative relating to this topic includes the EA 'Public Dialogues on Flood Risk Communication project 2015'. This project investigated the types of communications which could assist with the public understanding of flood risk and encouraging the local communities to take appropriate actions (EA, 2015b). However, the project did not propose any action plans.

Another government initiative related to this recommendation was suggested to be DEFRA Flood Resilience Community Pathfinder scheme (Interview, Government 1). It was launched in 2013 with the aim to engage local individuals and communities in managing flood risk and enhance the awareness in ways which improve their resilience to flooding risk. This scheme explored how different approaches can be adapted to incentivise and increase the communities' awareness, improve their knowledge, and provide insights into the public perception of flood risk. The scheme was ended in 2015.

It was suggested that the project affected the FRM landscape in three areas. Firstly, it assisted NFF to increase their knowledge in working with communities and to develop local solutions. It also led to set up a Community Engagement Hub on the NFF website which provides communities and individuals with guidance on how to enhance community engagement in risk management and presents examples of successful engagements. Secondly, for the government, the project offered insight into the practicality of community engagement. The outcome of the project suggested that community engagement is necessary to accomplish successful communication with the public to assist individuals prepared to accept and adopt property-level risk mitigation measures successfully. Otherwise, it could pose the risk of homeowners feeling short-changed in return for the PFR they receive if they think that they have not chosen PFR as a way to mitigate their flood risk (Interview, Government 1). Lastly, a key reason was suggested to be the high cost of

running community level schemes and the difficulty of quantifying the benefits. The Community Path Finder scheme suggested that on average, a three-year community engagement project can cost nearly £310,000. Successful community engagement requires building up a community before approaching them. This involves a wide range of activities such as identifying or initiating local representatives, developing trust and organising meetings. Further to that, due to a vast range of PFR measures and a variety of risk scenarios, it is hard to quantify the benefit of such schemes to different stakeholder groups (e.g. the EA, local government and the property owner). This makes providing a long-term reoccurring of financial support for similar projects challenging.

A government representative suggested that currently, there is no government agenda to invest further in this activity. However, it is hoped that through the Communication and Behaviour Change Task Groups of the Improving property level flood resilience action plan (DEFRA, 2016b), more practical options for this issue are developed. Ultimately, in interviews with representatives from NFF it was noted that despite government activities in aiding individuals following a flood event and facilitating and supporting community flood groups, issues discussed in Recommendation 11 still exist.

7.5.3 Conclusion of Recommendation 11

The recommendation regarding public education and more comprehensive risk communication was subject to two projects by DEFRA and the EA. The insurance industry representative expressed no awareness of any relative initiatives. A government representative suggested community engagement as an essential way to educate property owners of property level flood mitigation solutions and to develop better communications with the public. However, this approach seemed unlikely to be further funded by the government on a large scale due to the issues such as the high cost of community engagement and difficulty in quantifying the benefits to the stakeholder groups. In conclusion, the level of implementation of Recommendation 11is understood to be partially implemented: ongoing work continues.

7.6 Licensing arrangements and restrictions on access

Box 7-5 Recommendation 12

[for engaged parties to] Finalise the scope and licensing arrangements for sharing of non-sensitive information between professional partners (DEFRA, 2010, p.66).

Licensing large datasets entails a large cost, which has to be weighed up on a cost-benefit basis (Ibid, p.44).

DEFRA 2010 suggested that the licencing arrangements and the cost of accessing data are barriers to improving the availability of property level flood risk information. This document reflected on different stakeholder groups expressed concern that a wide range of the EA datasets is being developed by integrating different third-party data products. For instance, under the Public Sector Mapping Agreement (PSMA), the government bodies have access to a range of large datasets such as Ordnance Survey digital mapping and geographical data. Whilst those EA datasets which integrate Ordnance Survey data can be readily used by members of government bodies, for the commercial sector including the insurers this level of accessibility is

restricted. A similar issue was noted with regard to the individual insurers' databases. For instance, it was noted that some individual insurers have internally produced flood risk models, the content and use of which remains confidential to individual companies due to commercial and licensing limitations. There was a concern that such licensing arrangements increase the cost of data, the complexity of obtaining information, and eventually prohibits data sharing between different organisations. It was proposed that the EA would continue working with the ABI to outline licensing arrangements so that the non-sensitive information can be shared directly with and between professional partners.

Two major insurers and a government representative agreed that from a general point of view, the issue of licensing arrangements for public sector information has been overcome through the open data Open Government Licensing (OGL) (Interview, Community representative 2; Insurance 3; Insurance 1). Under OGL, the EA modelled data and the area data such as surface water are now more accessible to all users. However, due to data protection considerations, OGL still prohibits the sharing and use of personal data and does not require insurers to license their data in return.

> *Open source data made it easier. But insurers will not licence their data back. Because they are customers' data and data protection is an issue even in giving that [data] to the government (Interview, Insurance 3)*

Under Flood Re agreement there are some requirements for the insurers to share information such as the specifications of the property and the claims data with Flood Re, however, based on the interview with Flood Re representative on December 2016, no specific licensing arrangement had yet to be agreed.

A representative from a leading insurance organisation highlighted that, although licencing has been made easier, there exist some licensing barriers to limit data sharing. However, a major flood insurer suggested that such limitations are not entirely undesirable for individual companies (Interview, Insurance 1). Some major insurers have more sophisticated datasets which in combination with their relatively more complex premium calculations enables them to estimate the risks more precisely. Data for these groups is their intellectual property which makes them protective towards it. The existence of such arrangements secures the profitability of data collection and modelling, not only for the specialised insurers but also for the major commercial data providers.

7.6.1 Conclusion of Recommendation 12

In summary, through the OGL licence and the open data agreement, the accessibility of the government data for the insurers and the public has improved. Hence, from the government point of view, this recommendation is regarded as implemented. Nevertheless, there is no licensing arrangement yet in place for the insurers to share their data with other insurers or the government bodies, due to data privacy and data protection concerns amongst the individual insurers and homeowners. Some insurance interviewees foresaw that insurers will be more open to releasing data under the Flood Re scheme. Based on the evidence discussed above, the level of implementation for Recommendation 12 was concluded to be partially implemented and subject to ongoing developments.

7.7 Chapter summary and conclusion

This chapter analysed the current validity, level of implementation, and the hindering factors of recommendations associated with the enhancement of data characteristics and wider disclosure of property flood risk data. The studied recommendations include: Recommendation 8 (ABI sharing data with the EA), Recommendation 9 (data sharing between LLFAs and the EA), Recommendation 10 (enriching the EA area based maps with property level information), Recommendation 11(risk communication), and Recommendation 12 (licensing arrangements and restrictions on access).

In summary, out of the five recommendations discussed in this chapter, four were regarded as being currently invalid, namely 8, 9, 10 and 12. The overall level of implementation of this category of recommendation was concluded to be not fully implemented considering that the common level of implementation was either not taken forward (Recommendations 10 and 8) or, not completely implemented (Recommendation 9), and partially implemented: ongoing work continues (Recommendation 11). The summary of reasons that limited current validity and hindered the implementation of these recommendations is presented in Figure 7-1.

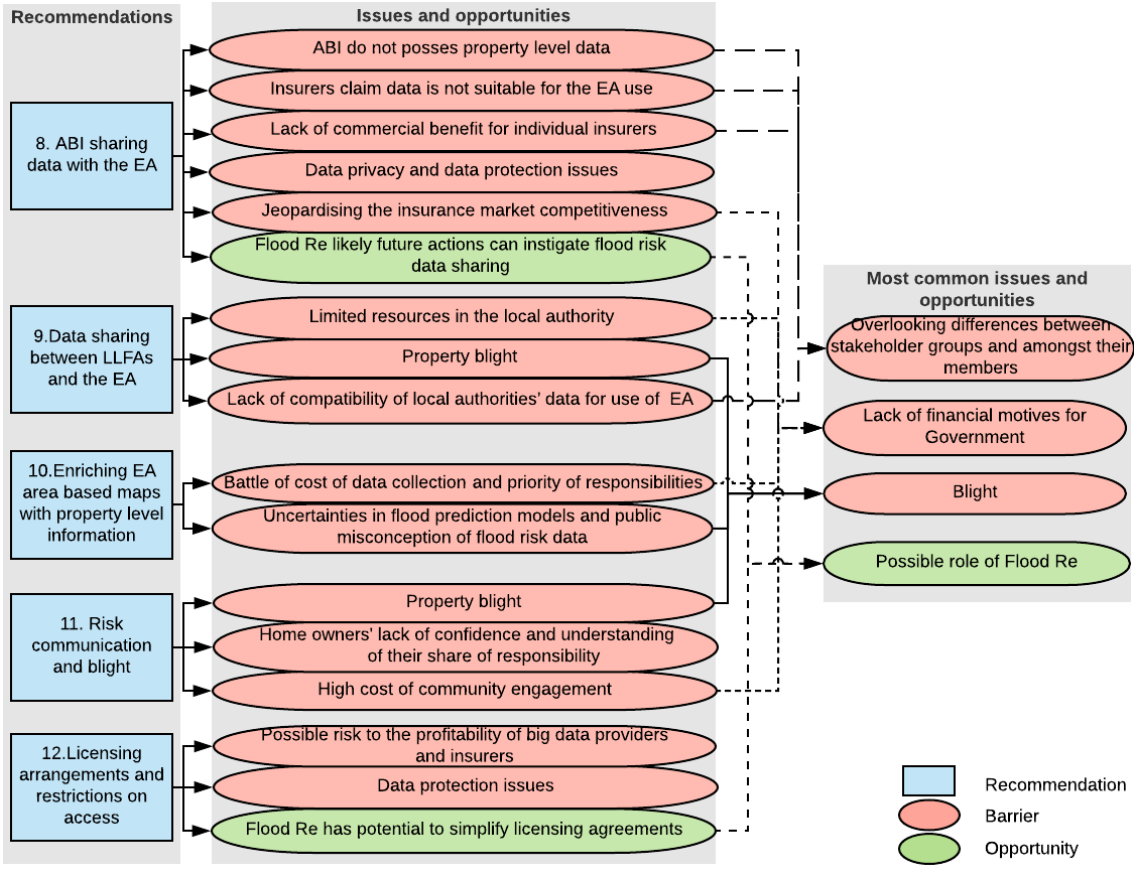

Figure 7-1 Summary of key factors contributing to the level of implementation of recommendations concerning data sharing and communication

In conclusion, this chapter draws on three key barriers towards implementation of recommendations associated with the improvement of currently existing data, to present a more detailed and micro level picture of properties at risk, as well as facilitating a wider communication of property flood risk data. These barriers are: overlooking the differences between stakeholder groups and amongst their members, property blight, and

lack of financial motives for the government. Figure 7-1 demonstrates these factors and their connections to the individual recommendations.

Recommendations often overlooked differences between, and amongst the members of stakeholder groups including the limitation of their role, and the compatibility of the currently available data for multi-purpose uses. Diversity of actors can lead to differences in the framing and reframing issues (Dewulf, Craps and Dercon, 2004) and challenges in the creation of co-ownership of the solution among all groups (Pahl-Wostl and Hare, 2004). For instance, the local authorities suggested it is unlikely that in the future more detailed data are shared since their detailed data is not suitable for the EA mapping and flood modelling. Although it may be expected that such differences would exist, given that representatives from these stakeholder groups had an active role in developing DEFRA 2010, DEFRA 2011 and EA 2010, it is possible that the significance of these differences only became apparent in the course of developing and attempting to implement the incentives discussed in this chapter.

Rules are necessary to define authorities and to specify the task of the different actors. Rules also specify the rights one actor has in relation to another. Rules, therefore, reduce uncertainties (Driessen et al., 2012). The absence of clear regulatory support, in form of a formal rule, and the hard-to-justify financial motives for the government bodies was the second key barrier in developing PLFRD in specific, and any property level flood risk actions in general. From risk assessment to instigating community resilience through education of communities and individuals, property level flood risk action at a national scale is experienced to be costly for the government bodies such as the EA and the local authorities. As a result, property level information was not, and is still not, a priority for the government, notably the EA.

The last key barrier was the concerns regarding the effect of blight on properties following the signposting the properties at risk, in a market where the buyers are not educated to have a realistic interpretation of such data. Precautions need to be taken into consideration of how to address concerns discussed in this chapter.

Following the framework used in Chapter 6 and Chapter 7, the next chapter presents the result analyses of the last group of recommendations with regards to PLFRD and the topic of property level protection.

Chapter 8: Property Level Flood Resilience and Resistance Data

8.1 Introduction

Continuing with the pattern adopted to develop the last two chapters; this chapter presents the implications of Recommendation 1 and Recommendation 2 regarding the effectiveness of property level Flood Resilience and Resistance measures and adaptation of relevant data into the insurance system.

Property level Flood Resilience and Resistance (PFR) generally refer to interdependent product-based measures undertaken by individual property owners to mitigate flood risk to their homes. It provides a lower standard of protection compared with capital community defence schemes and requires much lower capital investment. These measures are recommended for the areas where the flood defence schemes cannot be justified. Additionally, the technologies and approaches to protect properties are often more flexible and therefore applicable. Although unlike the larger scale flood defence, PFR does not alter the risk characteristics such as likelihood and severity, they provide individuals with the opportunity to manage the effect of the flood on their properties (ODPM, 2003; DEFRA, 2012b).

This chapter begins with an overview of the level of implementation and specific contributing reasons for each recommendation. This is followed by discussing the contributing factors and aspects of the PFR which were not directly addressed in the DEFRA 2010 and DEFRA 2011 but suggested to be influential during the data collection stage. The final section of this chapter subsequently summarises the conclusions from the discussions.

8.2 Incorporating property level protection data into the insurance underwriting

Box 8-1 Recommendation 1

DEFRA should commission a research project to look at incorporating localised flood risk information, including information on property-level protection, into insurers' underwriting (DEFRA, 2011b, p.13).

The benefits of doing this [PFR uptake] should be passed on to the property owner in the form of reduced insurance premiums (DEFRA, 2010, p.45).

DEFRA 2010 recommended that if PFR data is incorporated into insurance underwriting, it can provide an immediate financial reward for the individuals who adopted PFR and encourage PFR uptake. It was also suggested that this could offset the risk of detailed property level flood risk information increasing the cost of insurance and causing blight. The suggested lead organisations to implement this recommendation were the Association of British Insurers (ABI), the Environment Agency (EA), Local Government Association and National Flood Forum (NFF). Similarly, in DEFRA 2011, a research project was recommended to examine how localised flood risk information, including information on property-level protection, can be incorporated into the insurers' underwriting process. It was argued that such data can assist with calculating the actual risk

to the properties and therefore, be beneficial to insurance underwriting. It was anticipated that a related DEFRA project would go out for tender shortly. Two relevant projects were suggested.

i. DEFRA Flood Resilience Community Pathfinder scheme

For this recommendation, only the representative from DEFRA could suggest related initiatives. The rest of the interviewees expressed no awareness regarding any initiative that might have had effectively influence on the insurance market in regards to this topic. Firstly, it was suggested that this topic was briefly investigated in DEFRA Flood Resilience Community Pathfinder scheme 2012 as one of the economic activities of the scheme. This included work with insurers to reduce premiums for properties with flood protection and promoting PFR. However, the project's attempt to negotiate better terms for flood insurance was reported as being unsuccessful (Interview, Government 1).

ii. BRE Property Flood Resilience database 2014-2015

In addition to the Scheme, the same interviewee suggested two non-DEFRA initiatives including the BRE Property Flood Resilience database 2014-2015 (PFR-d) as discussed in detail in section 5.2.

The following issues were suggested to explain the level of implementation of this recommendation.

8.2.1 Termination of SoP

There is evidence that by 2010 it had been almost a decade since the insurers had begun to look for a fundamental revision of their agreements with the government (Huber, 2004). Despite several attempts to change the terms, i.e. in 2001, 2003 and 2006, the original agreement remained without fundamental changes. Eventually, in 2009, the industry decided that it would exit the historical agreement of Statement of Principles by 2013. There were a variety of reasons behind the desire to replace the existing SoP agreement. Firstly, new insurers with little or no pre-existing high flood risk business have entered the property insurance market as non-ABI representative members. The new firms were not restricted by the terms of SoP, whilst the ABI members had to comply with the terms of SoP and continue to provide insurance for their existing consumers at high flood risk (Interview, Insurance 3), a situation supported by Penning-Rowsell, Priesta and Johnson (2014). Therefore, the flexibility of these new members in selecting lower risk clients gave them an exclusive competitive advantage which distorted the market to the detriment of ABI members. Secondly, the industry was concerned about the quality and quantity of flood defences (Interview, Insurance 6). Thirdly, the Statement of Principle (SoP) agreement required flood insurance for properties, provided that there was sufficient funding for permanent flood defences. However, there were rising concerns that due to Government budget cuts, the flood defences may not be to the level that the industry was expecting. This exposed the insurers to the growing flood risk.

Eventually, in the SoP 2009 revision, insurers suggested considering the removal of the statement of principles in 2013 with the market operating freely thereafter. However, it took the government a while to realise the severity of the industry's decision. A major insurer noted:

> *It took them [the government] a long time to recognise that we are serious about [termination of] the SoP and we are not happy and we are going to close that down and we needed a change* (Interview, Insurance 3).

Between late 2011 and 2015, the insurance industry was focused on negotiating the terms of the Flood Re scheme. A government representative suggested that before finalising the new agreement between the government and the insurance industry (i.e. the Flood Re agreement), the insurance industry, although open to negotiation, was hesitant to commit to any other agreements or engage in any changes to what was previously agreed between the two (Interview, Government 1). Additionally, it was suggested that before finalising this new agreement between the government and the insurance industry, although open to negotiation, the insurers were hesitant to commit to any other agreements and engage in any changes to what was previously agreed in SoP (Interview, Insurance 6). It was only in 2011 that the long official negotiations between the industry governments started. It seems that recommendations made during 2010 were suggested as a 'quick fix' to address the issue and the agreements in the SoP 2009 without addressing the industry's frustration. Whilst the government reports notably the DEFRA 2010 and EA 2010, were trying to address different areas half-heartedly, the industry was preparing to inaugurate negotiations for a fundamental change. On a more general note, this issue could have affected similar recommendations which required direct insurance industry involvement including recommendations 3, 4 and 7 discussed in Chapter 5, but there is no evidence of this.

8.2.2 Issue of cost benefits

Another barrier was the lack of financial attraction or business opportunity for flood surveys and flood insurance in taking PFR into consideration. However, this contradicts the actions suggested in the recommendations mentioned above. Firstly, any modification to the current premium setting algorithm and IT will increase the direct cost to the insurer. Likewise, obtaining additional data is time-consuming and costly. A major insurer noted:

> *Asking about the condition of the house and measuring it would make a horrible long conversation, where the consumer can tell you the absolute truth or have misunderstood the situation* (Interview, Insurance 1).

The additional cost would either have had to be absorbed by the insurers, increasing their costs instantly, or could have been reflected in the final cost of the insurance product, which would have made it less attractive in the market. Although this approach could have helped the insurers to assess the risk more accurately, there was not enough evidence to justify the insurers undertaking such an adjustment.

8.2.3 Uncertainties in PFR Effectiveness

Additionally, it was suggested that the industry as a whole is not yet convinced of the effectiveness of PFR. PFR was often referred to as a large financial investment which the insurers are the ones who carry the risk if it fails to perform properly (Interview, Insurance 3; Community representative 3). This issue links Recommendation 1 to the next recommendation where a lack of confidence in the effectiveness of PFR was acknowledged and it was subject to further discussion between the government and the insurers. This issue is discussed in detail in section 7.3. Whilst PFR might reduce claims on a building structure, insurers still

receive claims on contents as well as on the finishes, fixtures and fittings, which according to Association of British Insurers (ABI) (2009) comprise up to 70% of the cost of the reinstatement.

In relation to the low demand for PFR information from the individual insurers, a representative from the surveying industry suggested that a collection of such data offers few business opportunities for property flood surveying activities. Following a flood event, their main goal is to organise the repair process as fast as possible at the right cost. Not only do the insurers not ask for such data but also there is little demand from the current or the new property owners for PFR (Interview, Insurance 6). This interviewee described PFR data as '*a hidden secret in the surveying business'* and '*something that might be nice to have, [which] doesn't even get onto the radar'*. Consequently, this creates a very limited market for PFR data collection and thus offering very small income potential.

8.2.4 PFR as a choice

This recommendation implies government's perspectives on the role of insurers' and homeowners' in managing risk to individual properties in two ways. In this recommendation, flood insurance is seen as a reward or punishment mechanism where individuals are treated depending on the outcome of their investment in reducing their flood risk. The second implication of this recommendation is towards property owners by accounting them responsible for reducing flood risk to their properties. A community representative suggested that:

> *I do not think that it [property level flood protection measures] is going to be considered in the building regulations. I also think it should not be included in building regulation as it is an invasion of privacy and a nanny state gone too far* (Interview, Community representative 3).

Additionally, it has already established that PFR can be costly. It should be the property owners' decision whether they want to spend that money. Additionally taking up mitigation measure can affect the lifestyle of individuals at risk. Hence, there is a view that it should be a choice of individuals rather than a government obligation.

> *People think that it [adopting PFR] is going to change their lifestyle and they don't want to live like that. Because you will not have a nice warm carpet in the winter months, electrics are high up there, there is going to be a stainless steel kitchen which you may not like* (Interview, Insurance 3).

This autonomy encourages a degree of self-reliance that is supported by making a variety of choices (both in mitigation products and strategies and in insurance products) available (see Section 7.3). However, unless individuals are in a position to be able to make informed choices, the power that comes with the autonomy and the availability of options does not necessarily instigate property level flood risk protection.

> *In the next step, you need to educate people who live in flood areas, which is difficult. And you need to educate them before the chaos and improve their understanding of the flood risk and the available options* (Interview, Government 4).

Therefore, incorporating PFR into the insurance underwriting system as a way to encourage the property owner to adopt PFR is dependent on how well the property owners are aware of the consequence of their decisions.

8.2.5 Effect of Flood Re on the need for data

The process of forming Flood Re was the immediate reason why, despite the initiatives noted above, this recommendation has not been implemented into the insurers underwriting process. The interviews' results suggested that between 2010 and 2015, insurers' behaviour was greatly influenced by the forthcoming changes in terms of the property flood risk agreement between the government and the industry.

Alongside these barriers, there is a strong case for Flood Re positively affecting the insurance industry's appetite for PFR data in the future emerged from the interviews. In the short term, there was a concern that Flood Re could have a dis-incentivising effect on the need for property level data and on the insurers in adopting PFR data. From this view, it was argued that Flood Re now exists and the majority of the properties at high risk are protected by this scheme (Interview, Insurance 1). Therefore, insurers become less keen to invest in seeking information about PFR, as they can cede severe cases to Flood Re and not worry about them. In the long term, however, this effect was expressed to be positive. It was suggested that the industry is well aware that Flood Re is a temporary scheme and they must invest in alternatives as Flood Re will come to an end (Interview, Insurance 1; Insurance 3). Flood Re has a limited 25-year lifespan. There is a need for the industry to be prepared for the time after Flood Re and move towards risk-based pricing.

8.2.6 Conclusion of Recommendation 1

Interviews with the insurance representatives clearly stated that despite DEFRA's studies, underwriters do not take resilience measures into account. Henceforth, there is very limited evidence on whether this recommendation was addressed successfully, therefore, the level of implementation of Recommendation 1 is regarded as not taken forward.

Interestingly, although the validity of Recommendation 1 at the time was suggested to be unproven, its current validity was not completely dismissed. Changes such as improvement in government and insurance industry relationships following the Flood Re negotiation was noted as the main reason.

8.3 Proof of PFR effectiveness

Box 8-2 Recommendation 2

[It was suggested for]ABI and BIBA to work with DEFRA to develop evidence around effectiveness and impact of property-level measures, so that these measures may be taken into account by insurers in the future (DEFRA, 2011b, p.26)

DEFRA 2011 Working Group 3 proposed that potentially, insurers need to take PFR data into account to incentivise households to protect themselves against flood risk. DEFRA 2011 suggested that lack of evidence of PFR effectiveness discourages insurers from taking PFR into account. It was suggested that the insurance industry is not yet confident in the effectiveness of these measures in minimising the risk, and if they are, whether the effect can be quantified in monetary terms in order to accurately understand the effect on costs of

claims. It was recommended that if the industry is presented with sufficient evidence, they will be more open to the idea. Thus, it was recommended that together with the ABI and the British Insurance Brokers' Association (BIBA), DEFRA will develop evidence to increase the insurers' confidence in the effectiveness of property level measures. In that regards, DEFRA also suggested exploring the idea of running a resilient repair pilot, where households affected by the recent flooding can receive support to negotiate resilience repair options with the insurers. The DEFRA interviewee suggested the following initiatives in regard to this recommendation.

Two distinct examples in the literature are DEFRA (2012) *Establishing the cost-effectiveness of Property Flood Protection - FD2657,* and DEFRA (2014) *Post-Installation Effectiveness of Property Level Flood Protection Final report- FD2668* where the issue was studied from financial and functional aspects, with the main focus on the benefit to householders. In 2012, DEFRA commissioned a study which suggested that PFR can be effective in reducing the damage significantly (Interview, Government 1). Six PFR packages were analysed within the range of 34 property types. In total, the cost-benefit of resistance measures was estimated between 1 in 1 for properties at highest risk and 5 in 1 for properties at a lower risk. In 2014 a follow-up DEFRA study suggested that during UK 2012 floods, in 84% of the cases, PFR measures were effective against the effect of flooding. Reasons for the 16% that failed were attributed to the issues regarding their installation and function of the measures, maintenance and storage; and in some cases the expectations, awareness and understanding of the homeowner. Similar results were obtained from parallel studies such as EA (2009), EA (2012), DEFRA and EA (2015) and Lamond et al. (2018).

The recent improvements in standards were another step towards improving the trust in PFR effectiveness including PAS 1188 (2014) which is the British Standard Institution for flood protection products, and the BS 85500 (2015) about flood resilience repair (Interview, Government 1). PAS 1188 covers specifications for building aperture flood protection products whilst BS 85500 formalised the findings of an earlier government publication, *Improving the flood performance of new buildings, Flood resilient construction* (DCLG, 2007). In 2015, BS 85500 was updated to reflect the growing requirements for improving flood performance of buildings using modern methods of construction (bsigroup.com, 2017). Despite the suggested improvements in the standards from a government representative point of view, representatives from major insurers argued that such improvements did not noticeably affect the industries' trust on PFR. He suggested that for the first step, the insurance industry requires standards or codes of practice on PFR testing regimes and facilities so that the industry can rely on their performance (Interview, Insurance 3).

Additionally, there have been some improvements in the creditability of PFR systems amongst the insurers following the PFR supply market growth. Supply market growth entailed improvements in the understanding of flood risk and the suitability of their products, which positively affected the credibility of these measures amongst the insurers (Interview, Insurance 3). For instance, there is a gradual increase in the number of automatic and passive PFR systems in which *'insurers can take more satisfaction that they would work'* in comparison to the manual PFR systems (Ibid). This improvement was also acknowledged by DEFRA (2014), suggesting that this development was the by-product of the DEFRA and the EA PFR grant schemes during that period.

In summary, it seems that the topic of developing a proof of PFR effectiveness has been subject to a number of projects and studies, directly or indirectly. Interview with the insurance industry representatives established that despite these efforts, this issue has not been resolved yet (Interview, Insurance 3; Insurance 6). Similarly, a community representative also agreed that there have been several attempts to improve confidence in the effectiveness of PFR. However, he warned that *'there is a huge frustration amongst the stakeholders that it has taken so long'* (Interview, Community Representative 1). Several reasons were suggested to explain insurance distrust in the effectiveness of PFR. The uncertainties lay in different steps of adopting PFR, from estimating the risk to the point where implemented PFRs need to function in a real flood situation.

8.3.1 Barriers

Insurers' uncertainties and concerns regarding the performance of PFR include those that exist during the assessments and preparations preceding the installation stage and those that are following the installation and onwards. The first type of uncertainty was expressed to be the quality of the property's vulnerability estimation. It was suggested that it is almost impossible to ensure that all the relevant vulnerability details are captured. Property level flood risk assessment is complicated and there are very few surveyors that understand and are trained in flooding risk. For example, there might be some wiring hidden in the wall that cannot easily be seen (Interview, Community representative 3). Additionally, any vulnerability assessment is merely a snapshot in time and subsequent changes to the property that might alter the vulnerability cannot be captured. Examples can range from physical changes such as an extension to small modifications such as creating a hole in the wall so that the television cable can pass through (Interview, Government 1). A similar issue was noted in the DEFRA (2015) study.

Selecting the most suitable products is often based on the individual's knowledge and does not follow uniform standards. The homeowners have to buy from builders and suppliers who know even less about PFR For instance, an interviewee noted;

> *The general builder is fine as far as there is a change in general repair or recommendations [for change] concerns a simple change in routine building processes such as moving up sockets or install a kitchen. However, they are not expert in more sophisticated changes and adaptations if needed, such as to tell where to stop the water* (Interview, Government 4).

There are no common BS standards as a guide to detecting the most suitable product for different risk scenarios.

The second type of uncertainties concerns the selection of the PFR and its performance during flooding. It was suggested that providing individuals with PFR does not guarantee that they are effectively used. For instance, often PFR were seen as effective as a package rather than single measures. Installed flood barriers on the doors are not effective if non-return valves on the drainage or covers on the air bricks have not been installed (Interview, Insurance 1). Another example is the concern regarding the long-term storage and maintenance of products; whether the installed measures are maintained and stored in their optimum conditions. For instance:

> *The equipment can deteriorate or be damaged by rodents. So although it is absolutely fine that the household members trust the flood barrier that they have stored in the garage, there's a good chance that it will not work* (Interview, Insurance 1).

> *Through personal experience of visiting some flooded sites, some of these barriers that you're supposed to put against your front door are stored at the back of the garage with lots of stuff in front of them so to get to it is quite difficult* (Interview, Insurance 3).

This could also affect the level of readiness at the time of emergency, which raises another issue. This suggests that the basic knowledge that is required for developing and increasing confidence in the effectiveness of PFR include understanding the flood risk, understanding the building and, in addition, understanding the person.

8.3.2 Role of lobbyist

One of the key findings of this study is the surfacing of secondary stakeholder groups or the lobbyists and their role in the future of property level flood risk management and PLFRD. Lobbyists are stakeholders who often do not have a direct policy role of influence in flood protection but rather have a policy interest in the bigger picture of resilience with a strong interest to pursue any decision that can affect the future of PFR. Their influence, although found to be less direct compared to the three key stakeholder groups discussed in this study, were still noticeable. Amongst them, it was suggested that the two groups are the most influential. The first group is the flood protection industry including PFR installers and manufacturers companies who are strongly interested to pursue and influence the decisions and policies that can alter the size of the PFR market. A major flood insurer suggested that:

> *Companies that supply [property level] product would also be interested to see how PFR goes and whether that market grows or shrinks. If you are one of those companies, you would lobby to death to get it [the PFR policies] implemented because it means that there is going to be more business for you* (Interview, Insurance 3).

The second group of lobbyists are the housebuilders and construction communities. It was suggested that they are resistant to the effect of any decisions that can alter the current building and repair processes.

> *The housebuilders do not want anything which makes building any more difficult than what it apparently is. I remember a chap from National House Building Council said that they are really pleased that they killed off flood in the housing regulation* (Interview, Government 1).

These rather hidden forces increase the complexity of implementing PFR. These forces include the interest of a variety of powerful business sectors with diverse views towards the future of PFR.

8.3.3 Opportunity

A major insurer suggested that there are more successful PFR cases in major flood insurers' records which are positively affecting their view towards PFR effectiveness. One of the major insurers noted that '*we have internally enough cases that we can say that it [PFR] does make a difference, but we do not share [that data]. We are quite comfortable in their positive effects and have the evidence that suggests that'* (Interview, Insurance 3). Whilst it still remains an individual insurers' right whether to acknowledge PFR effectiveness

or not, a major insurer suggested that there should be similar evidence in some other major flood insurers' databases. He argues that in case of flood risk and PFR, the fact that the industry is not standing against it should be perceived positively.

> *If the insurers were receiving lots of claims where property level protection measures have failed, they have been making a huge amount of noise about it. So I think the silence speaks volumes* (Ibid).

Another insurer agreed that:

> *Insurers have a very strong memory of individual cases, good and bad. They will go back to some claims happened 25 years ago across the whole UK as to a reason why we do something. It works positively as well. For example, we know about the case of Cockermouth toyshop9. That is good enough for us* (Interview, Insurance 4).
>
> *Suddenly, you have got this [PFR] market that has developed and matured. There has to be some value in it otherwise it would not have existed. I would not exist if these measures have failed. So on that basis, I think suddenly the insurers feel that it is okay, we have got enough history now of this system being successful* (Interview, Insurance 3).

There seem to be enough successful PFR examples (See section 7.3.3) that some members of the industry see some value in exploring the idea, otherwise, PFR market would not have been born and continue existing. However, it seems that although the present evidence positively acknowledges the effectiveness of PFR, this effect is not yet quantified. The opportunities including Flood Re and BRE PFR-d project (see section 5.2) can facilitate possible opportunities to evaluate the effectiveness of PFR in long-term (Interview, Insurance 3). This information and the database that will be created during the course of these projects can be used to develop evidence on the effectiveness of PFR and build confidence for the early adopters of PFR as a potential solution. However, their effect on the topic is yet too early to be evaluated.

8.3.4 Conclusion of Recommendation 2

Despite the positive outcome of DEFRA studies on PFR effectiveness, due to the absence of insurance direct engagement, these studies did not incentivise insurers to incorporate such data in their premium setting process, as it was proposed in Recommendation 2. Therefore, it was concluded that Recommendation 2 was not taken forward. However, the interviews suggested that the topic proposed was a valid requirement at that time and it has maintained its validity. The success of PFR not only depends on investment in understanding the flood risk, building and the property owner but also it requires the careful consideration of the stakeholders involved.

[9] The toy shop in Cockermouth is a well-known case of successful PFR in a commercial property. The shop was flooded in 2009, and was left with severe loss. It got back to business after six months. Since 2009, the owner installed flood resilience measure. In 2015, the shop was flooded again and managed to start trading within few days.

8.4 Chapter Summary and Conclusion

This chapter presented the results of analysing the factors that affected the level of implementation of Recommendation 1 and Recommendation 2. In summary, the lack of evidence on PFR effectiveness was discussed as the key discouragement for insurers to take PFR into account. Lack of confidence seems to be cast over both pre and post PFR adaptation and installation. A summary of the principal factors is presented in Figure 8-1.

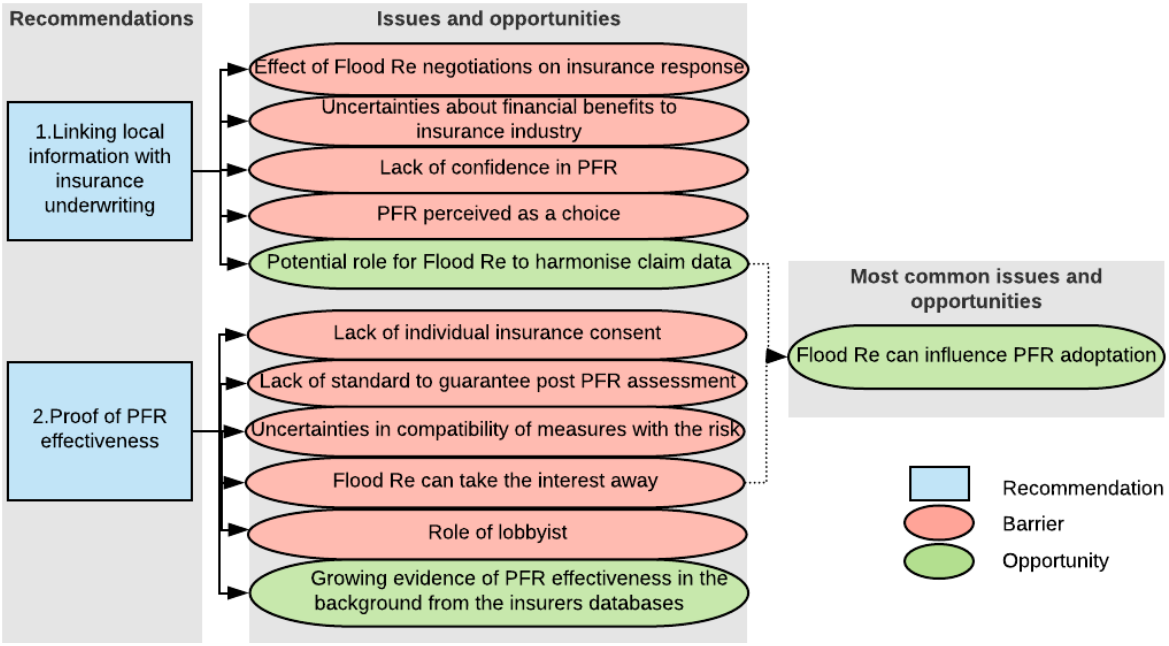

Figure 8-1 Summary of key factors contributing to the implementation of recommendations concerning property level resilience measure data

In conclusion, although the initiatives did not lead to the implementation of the suggested recommendations, they have illuminated new aspects regarding this topic. Firstly, it was evident that the implementation of PFR is more complex than was perceived between 2010 and 2011. The performance of PFR in mitigating flood damage is not only a congregation of a variety of factors such as building characteristics, flood specification and homeowner's behaviour, but also is affected by the possible change of each factor over time.

Secondly, the analysis suggested a new distinction between the government and the insurers' position regarding the adaptation of such measures. Where the government shows the characteristics of the 'guardian' in time of emergencies, insurers act of the market value (Jacobs, 1992). Following their peak and drop of interest towards PFR between 2009 and 2010, the government seems to have been developing a more stable position. There is now less desire for direct methods of engagement due to several issues that came to light during their past experiences such as financial burden on taxpayers and the risk of setting a precedent for government engagement in PFR. One of the positive outcomes of the direct government intervention between 2009 and 2015 was the improvement in the quality and quantity of the PFR supply market and the rise of evidence of PFR effectiveness from insurance databases. This has instigated the interest of the insurance industry towards PFR, despite their previously suggested limited interest in the matter. The formation of

Flood Re and its role in guiding the insurance industry to a risk-based pricing approach (Christophers, 2019) which can further supports the readjustment of industry's progress towards more engagement and a better understanding of the factors that increase or reduce the level of risk by including PLFRD.

Prior to closing this chapter, a summary of the three analysis chapters seems appropriate. This will help the reader to gain a comprehensive perspective of the overall influencing factors discussed with regards to the topic of PLFRD. This is regardless of the categorisation adopted for organising the discussions and findings. It will also provide a transition step, before moving to the next chapter and generalising the finding of the study.

8.5 Summary of the analysis chapters

In chapters 6 to 8, the 12 recommendations extracted from three government documents were analysed in three distinct groups including:

1. Harmonised collection and storage of data
2. Active multi-stakeholder property level data sharing and dissemination
3. Property level flood resilience and resistance data

Table 8-1summarises the findings of the analysis chapters. The findings from the interviews suggest that eight out of twelve recommendations were either not taken forward or not completely implemented. Only four are currently subject to further work. This suggests a rather low level of accomplishment.

Table 8-1 Summary of the level of implementation of recommendations 1 to 12

Recommendations		List of relevant initiatives	Level of implementation until March 2017
Chapter 6 Data consistency and standardisation	3. Standard risk assessment survey data	EA 2010 DEFRA 2015 BRE database	Partially implemented: ongoing work continues
	4. Standard damage and claims record	Flood Re	Not taken forward
	5.EA as the single source of data on the impact of flooding	Resilience Direct	Not taken forward
	6. Awareness of information sources and data accessibility	Centre4 Resilience OGL	Partially implemented: ongoing work continues
	7.Developing a tailored report tool to reflect end users' needs	DEFRA Calculator	Not completely implemented
Chapter 7 Data sharing and communication	8. ABI sharing data with the EA	___	Not taken forward
	9.Data sharing between LLFAs and the EA	FWMA 2010	Not completely implemented
	10.Enriching EA area based maps with property level information	___	Not taken forward
	11. Risk communication and awareness	Pathfinder Scheme Property flood resilience action plan	Partially implemented: ongoing work continues

	12. Licensing arrangements and restrictions on access	OGL Flood Re	Partially implemented: ongoing work continues
Chapter 8 PFR data	1. Incorporation PFR into insurance underwriting	Pathfinder scheme 2012 BRE database	Not taken forward
	2. Proof of PFR effectiveness	DEFRA FD2657 DEFRA FD2668 PAS 1188 BS 85500 BRE database Flood Re	Not completely implemented

However, this does not undermine the validity of the need for PLFR. The overall conclusion of the data suggested that the appetite for PLFRD still exists. Nevertheless, it was evident that whilst some issues and topics were reasonable, others were over-ambitious. The analysis offered a fresh view of the role of stakeholder groups in PLFRM. This view suggested that, in comparison to the 2010 and 2011 documents, the appetite has been subject to some changes and new patterns.

In order to obtain an inclusive view of these changes and patterns, the clusters of factors that were developed in the three analysis chapters were combined as shown in Figure 8-2. Influencing factors with a degree of similarity were grouped to assist with generalising the key promoting and prejudicing factors in the implementation of the recommendations 1 to 12. Key patterns and relationships were translated into four common influential factors that facilitate property level flood risk data with respect to the needs of key stakeholder groups. These factors include government priorities, the different nature of the stakeholders, market opportunities for PLFRD, and Flood Re. These factors and trends are discussed in detail, in the next chapter. Where it is applicable, relative barriers and opportunities are discussed.

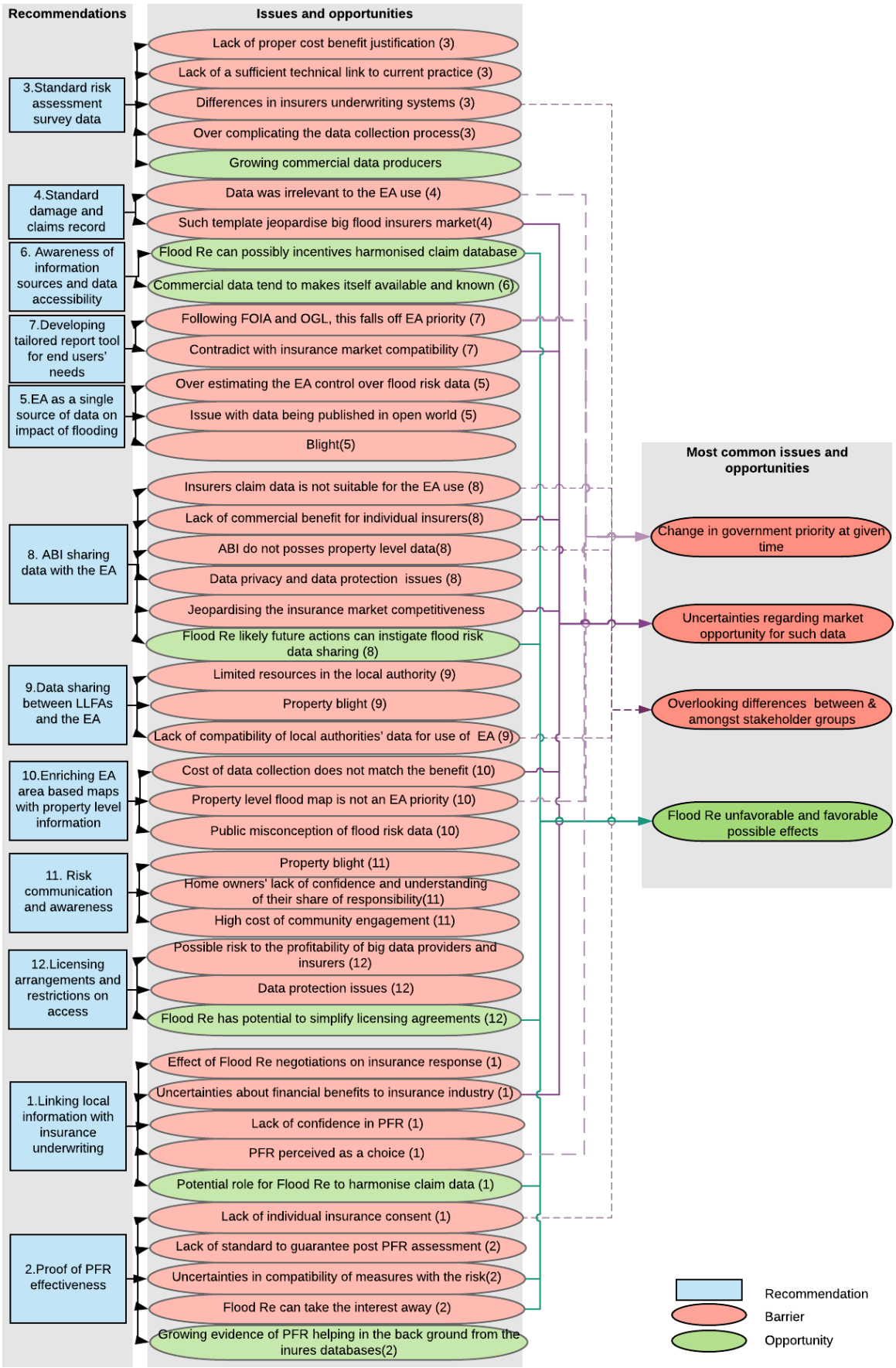

Figure 8-2 Summary and conclusion of key promoting and prejudicing factors in the implementation of PLFRD recommendations amongst the key stakeholder group

Chapter 9: Discussions

9.1 Introduction

The aim of this chapter is to reflect upon the conceptual model developed in Chapter 4 in response to the final objective of the research. This is achieved by incorporating the findings from the empirical exploration in the previous three chapters and discusses them in areas of focus derived from the conceptual framework. This includes discussions regarding the nature of the changes and discussing the key patterns and trends and their meaning in relation to the main research problem. Where relevant, the associated opportunities and barriers are discussed. The final section reviews and adjusts the conceptual outcomes to be better reflect the implication of the data analysis and findings.

9.1 Change in policy discourse

As discussed in chapter 4, the term discourse is adopted to describe one of the four main concepts that define the characteristics of govern case at a particular scale (Arts, Leroy and Van Tatenhove, 2006; Kaiser and Nikiforova, 2008; Thiel, 2010). In this study, it is used to describe the ideas and concepts that are produced and transformed in a specific set of actions by the actors which give meaning to their physical and social realities.

9.1.1 To PFR or not to PFR

One of the key findings of the research here, if not the most critical, is the change in the discourse of risk governance at the scale of the property. Government's position concerning the property level flood risk management from *the leader* to *a facilitator* which directly affects their interest in PLFRM data. As it was evident in DEFRA 2010, EA 2010 and DEFRA 2011 documents, the Government organisations were often suggested as the leading stakeholder groups for the implementation of the bespoke recommendations. For instance, *Standard risk assessment and survey data* (Recommendation 3) directly puts DEFRA in charge (DEFRA, 2010), and *Standard damage and claim record and Enriching EA area based maps with property level information* (recommendations 10 and 4) required direct action from the EA (ibid.). Despite the pronounced leadership role granted to them, the findings from the interviews suggest that the incentive to address the issues of property level flood risk data engagement has lessened and instead, an indirect facilitating role was observed.

This agrees with the bigger change that was suggested by Penning-Rowsell, Johnson and Tunstall, (2006) in the political and ideological context of FRM since the 1970s. They suggest one of the key characteristics of this change as the move from relying solely on state-help where the state is responsible for flood control to an approach where state help and self-help is balanced. As the finding of this study suggests, at the scale of individual property, a similar approach is evident. Instead, the state provides some degree of protection and risk control measures at higher levels whilst the individuals are expected to take responsibility for their own risk.

> *We want people to treat flood as burglary. Their attitude towards burglary is that I have my insurance (have a backup) and I lock my door (I take active measures to prevent). The attitude to flooding is ' I have my insurance, and I leave the door open because the government should have shut the door'* (Interview, Government 1).

For instance, recommendations regarding the EA as the single source of data on the impact of flooding (Recommendation 5), and Enriching EA area based maps with property level information (Recommendation 10) the critical point that is absent here is that although the Government organisations are responsible for flood protection, their legal requirements do not stretch to individual property risk management. However, the Government's intervention at property level flood protection is not uncommon, as flooded properties can easily accrue to become a national issue where the Government's direct aid and action are expected.

Although funding for FRM from central government has always been a key tool of fulfilling central government strategies (Penning-Rowsell and Johnson, 2015), findings suggest the nature of such intervention at the property level, is not a legal obligation but rather a political choice for the state. Reasons for that lay within the lack of consistent large-scale flooding take the flooding issue off the political radar, negatively affecting the centrally allocated funding available to it.

> *Whatever we do on flood prevention is highly expensive. Unless there is a political desire to invest more money there is a limit to what can be done* (Interview, Government 4).

On the basis of the extent of the damage in any large-scale event, the Government decides which flooding emergencies it steps in for support and intervention. Small-scale flooding is common and widespread in England which is dealt with locally with no requirement for central aid support. Central Government direct intervention for property level flood risk management is only triggered during national disasters which follows a pick and drop pattern. It rises following a national or large scale flooding and falls following the period between the two big events. For instance, DEFRA Property Protection Grant Scheme 2009 – 2011 for recently flooded properties, 2013 Repair and Renew grant scheme and December 2015 flooding, when people were re-encouraged to take on property level schemes.

> *These things have a very short political life before things move on and people start to forget about it and another thing takes over. A lot will be determined by how far the ministers want to go. It is more complex than that* (Interview, Government 4).

> *Whatever we do on flood prevention is highly expensive. Unless there is a political desire to invest more money there is a limit to what can be done* (Interview, Government 4).

This type of intervention through Property level Flood Resilience and resistance (PFR) introduces a new characteristic to the way the Government is approaching the issue of flood risk at the property scale. Instead, in order to secure the support for protecting individual properties, DEFRA has moved towards reducing its role as a leading figure and adopted a rather indirect, facilitating and enabling the role.

9.1.2 Form commander to the facilitator

The new discourse of FRG at property scale also complies with neoliberal characteristics of that has been attributed to the FRM in England in general by Penning-Rowsell and Johnson (2015). It marks the moving

away from direct, 'command and control' state action and seeks a market solution for the problem (Christophers, 2019). For instance, a major insurer suggested that:

> *DEFRA sees it as a collaboration between industry and the Government. That means that DEFRA will facilitate it in the right direction but the industry will carry it out* (Interview, Insurance 6).

This changed the Government's PFR approach from *driving the changes* towards *partnership* between the public and private sector through supporting match-funding (co-funding) a joint outcome. This can be seen in correspondence with a wider set of shifts in the England approach to governance in general towards neo-liberalism as discussed earlier in this study in Chapter 2. Similarly, two government interviewees suggested that:

> *Therefore the Government is working with groups like Bonfield to encourage the sector itself to do more to promote PFR* (Interview, Government 1).
>
> *My scene is that [actions such as] the Bonfield report is about encouraging the industry to do more where it can as opposed to imposing a major change in policy* (Interview, Government 4),

The government attitude towards PFR can be generalised to their attitude toward PLFRD. As it was discussed for Recommendation 9 (Section 6.3) and Recommendation 10 (Section 6.4), the EA and local authorities have limited their role in providing data to provide the indication of risk possibility and have passed the responsibility for further investigation to the insurer and homeowner.

9.2 Power

Power distribution and the degree of power shared between the central state and other stakeholders are one of the key factors that assist with successful multi-stakeholder incentives (Green and Penning-Rowsell, 2010). Oversimplification of the nature of power and the engagement barrier can pose risk to partnership collaboration is (Tseng and Penning-Rowsell, 2012). As Reed (2008) discusses, the participation of the stakeholder does not happen in a power vacuum. Rearranging this power, here through data sharing and risk communication can lead to both negative extractions with the existing power structures.
This suggests that failing to acknowledge such inequalities and the differences in their power may even lead to reinforcement of the current inequalities and therefore, weaken the legitimacy and reliability of the stakeholder engagement. Well defined objectives, a good understanding of restrictions, the degree of power or influence of actors is also relevant issues here (EA, 2005a; Cornell, 2006; Reed, 2008). Findings suggest that such imbalance of power can be seen amongst the members of government organisations and members of the flood insurance industry.

9.2.1 Individual insurers, different risk appetite, and a different value for PLFRD

As discussed in Chapter 3, the UK insurance industry is a collection of a number of individual private companies. This makes this market quite fragmented. The analysis results demonstrate a strong presence of differences that exist within the insurance industry regarding the application of property level flood risk, and the 'risk appetite' of individual companies. Over the years, more and more individual insurers have moved

towards selecting risks. Some insurers have developed areas of specialisation based on their technical strength and reinsurance tie-ups, often described as the firm's risk appetite. Findings from the interviews suggest that the stakeholders often acknowledge a close relationship between the company's risk appetite for flooding and the value they put on PLFRD.

With regards to property level flood risk, insurers' risk appetite can be spread over a spectrum. At one end, there are insurers who are experts in property flood insurance and willing to insure even properties at high risk. This group consists of companies who have complex underwriting systems that are used for accurate risk pricing of individual properties. They adopt a risk-based approach using detailed data. Such detailed information is their '*unique selling proposition* '(Interview, Insurance 3) that *'gives an edge'* (Interview, Insurance 1) to their business. As a result, detailed data at the individual property level is a valuable asset to them. A data sharing activity can gain them little to no benefit since comparatively; they already own more comprehensive data sets. Therefore as Cosgrove and Rijsberman (2000) suggest for these powerful stakhoders there is risk that their involvement does not gains them sufficient reward or capacity to influence decisions that affect them(2000). Hence, this can negatively effect their motivation for engament.. At the other end of the spectrum are more general insurers i.e. those who are none specialised in flood risk insurance. This group uses flood risk information to obtain a general understanding of integrated risks in order to minimise their exposure to it (Interview, Insurance 6). Often, they do not have a large volume of properties at risk and tend to generalise risk factors. This group sells their products at a competitive price by keeping administrative costs low therefore they cannot afford to invest in obtaining a vast amount of detail on a property by property basis (Interview, Community representative 2). Thus, this group put less value on comprehensive flood data as it is not compatible with their approach. . From this view, with existence of such dissimilarities and imbalances ,sharing power (in form of data) can be perceived as a hazard and therefore lead to adverse reactions from the stakeholders who consider their benefits to be jeopardised (Involve, 2005).

Depending on where each individual insurer is placed on this spectrum; they would require different data in different forms and levels of detail. That said, in order to implement any sort of industry-wide standard information system successfully, it is necessary to convince a significant number of individual companies. This can be challenging due to dissimilarities discussed above. There is also the risk of reinforcing the positions of the already powerful actors (Cooke and Kothari, 2001) or alter the existing power structures which can entail unpredicted conflicts rather than the intended consensus (Sultana, Thompson and Green, 2008). In conclusion, it is evident that in formulating recommendations to improve availability and use of PLFRD, one of the main issues is an overgeneralised assumption of the stakeholder groups' approaches to the application and use of data. Consequently, approaches that were suggested to close the gap between stakeholders' data often overlooked the reasons behind these gaps.

9.2.2 Central Government and local authorities' data, different purposes

At first glance, it can be enticing to expect DEFRA and the EA to be first in line to tackle issue of property level flood risk management and flood risk data, knowing that DEFRA has the direct policy role on flood risk management and the EA is responsible for providing tools and information for flood risk management authorities. Between DEFRA and the EA, the leadership is less expected from the EA as it is a non-

departmental public body with limited power. Whereas, DEFRA has a larger credible role at the national level and has the power to carry out coordination work with the different stakeholder groups. One of the Government interviewees noted that:

> *In DEFRA, you can attach a minister's name to something and put a minister in front of a group of businessmen and say that I will do this if you do that piece of work for me and they will go away and do it. This is something that the chief executive of the EA cannot do* (Interview, Government 4).

Similarly, collaboration in environmental governance may not always lead to greater effective engagement of actors in the processes of policy or may not necessarily be felt by the collaborating partners. The main reason for this is the differences in actors in resources, technical knowledge, confidence (Lowndes and Sullivan, 2004). This was evident amongst the government organisations engaged in FRM. Data collected by the local authorities are not suitable for the use of the EA as the required level of precision to properly inform calculations and modelling (which can only be achieved through exact measuring) is not met (see Section 6.3). Data are mostly collected for the purpose of preparing applications for funding grants and flood protection schemes. The property level data in that regard are limited to a simple standard calculator used to estimate the cost-benefit analysis that incorporates indicating factors such as the number of properties benefiting from the proposed scheme. When no central fund is available, the local authorities' actions at the individual property level will be limited to emergency responses.

> *All this data is quite similar but slightly varies depending on what agencies and authorities are collecting. The EA and local authorities have certain boxes to fill; the council have others'* (Interview, Community representative 3).

Therefore, data produced by the local authority is designed to cover their specific use and generally does not contain detailed information about risk to properties. In the same way, Penning-Rowsell and Johnson (2015) suggest a mechanism such as local 'partnerships' may appear appealing to incentivise sharing of responsibilities across government, local and micro level flood risk measures. However, due to the high level of diversity in resources and capacity at these level, small local authorities would not be able to take in the new role (DEFRA, 2009d). This raises questions regarding the value of flood data collected by the local authorities for the EA mapping and modelling purposes.

9.3 Actors

Although preferably, analysing the stakeholders should be done prior to starting the participatory process, it should be seen as a dynamic process since the nature of stakeholders' views, requirements and interests at various phases can change (Reed et al., 2009). This makes re-assessment of the stakeholder's characteristics during the later stage of process equally important (Stanghellini, 2010). Overlooking these differences becomes problematic when trying to practice data standardisation, sharing data between members or inducing a mutual ground for collaboration. This was evident interviewees' responds to four different recommendations including in *Incorporating property level protection data into the insurance underwriting* (Recommendation 1), *Standard risk assessment and survey* (Recommendation 3), *Data sharing between ABI*

and the EA and overcoming the relevant legal obstacles (Recommendation 8) and, *Data sharing between LLFAs and the EA* (Recommendation 9).

It is critical to acknowledge and consider the discrepancy between actors' expectations and the reality of implementation and mutual agreements on not only the scientific facts but also the high deviation on values and standards (Hurlbert and Gupta, 2015). There is a degree of conflict of interest between the key stakeholder groups in property level information systems, where the data collected and generated by one group does not necessarily fully support the need and the function of the other. These differences include the scale of response to flood risk, use of data, the extent of their commitment to risk management and the value they put on PLFRD. These variations are evident between the two big data owners: the Government and the insurance industry. Naturally, the private and public sectors have different functions and lines of interest. Therefore, it can be expected that the information and IT-support each group uses is different. The following cases illustrate this issue in further detail.

Case 1) The cost and benefits of property level protection measures

Perhaps the divergence of views between the Government and the insurance industry on the PLFRD is most distinct on the topic of PFR as a risk mitigation mechanism. On one hand, since 2012 for the Government, property-level protection became a recognised means of addressing local flood risk, mainstreamed within the FCRM budget (DEFRA, 2012) and accompanied by studies focusing on providing evidence on its cost-benefits to the homeowners at risk (Recommendation 2). On the other hand, obtaining insurers' consent on accrediting PFR as a risk mitigation mechanism was ignored and liaison with the insurers was absent.

> *The point is that PFR has become a distinct policy strategy point for DEFRA and the Government without necessarily too much checking with the insurance industry that they buy into it* (Interview, Insurance 2).
>
> *In addition to that, PFR was not necessarily an open door to insurers and a recognised method of protecting properties. Insurers [in general] is not satisfied that PFR will protect the property* (Interview, Insurance 3).

Therefore, whilst the Government was promoting the convention that PFR and data relevant to PFR can be universally beneficial, the insurance industry remained disengaged with the idea. A barrier that has contributed to this state is, as discussed in section 3.4, that although the UK insurance system is a long-established economic tool in transferring and spreading the cost of the flood risk, historically they have not been involved in risk reduction or to incentivise resilience to limit the damage.

Another barrier that has hindered their shift towards active participation in risk reduction is uncertainty regarding financial benefits to the insurance industry and lack of confidence in PFR effectiveness as discussed in sections 7.2 and 7.3. Insurers tend not to trust things that they '*haven't had a hand in*'(Interview, Community representative 3). Thus, even if there is confidence in the PFR product quality and its long-term maintenance, a government representative questioned whether it would be cost beneficial to incorporate such data in insurance premium setting.

Case 2) The costs and benefits of resilience repair

Resilient repair shares a similar conflict of stakeholders' views as PFR as discussed above. Despite the Government's view on promoting resilient repair, findings from the interviews suggest that the industry is not yet prepared to promote property resilience repair through insurance. DEFRA studies suggest that the cost of installing resilience measures can be reduced significantly if adopted at the time of reinstatement following a flood. However, from the insurers' point of view, such savings are not valid. In 2009, ABI reported that to the insurers, the cost of resilient repair is 40% higher than traditional repair on average. Based on the 2007 flood claims data, depending on the type of the house, the average cost can vary significantly between 15% and 70% (ABI, 2009). It is also believed to prolong the reinstatement process as it often requires additional work and arrangements, thereby, causing delay and increasing the cost of temporary accommodation. For instance, one of the commonly advised resilience strategies in the repair progress is elevating electricity wiring. This requires the presence of a number of different authorities such as the property owner, the external electrician, to approve the change, otherwise, the repair process halts. Additionally, PFR is more likely to be economically worthwhile only if the risk has an annual chance of flooding of 2% or above that is 50 year return period or less (DEFRA and EA, 2008b). That means that for the direct insurers with a regular turnover on properties at risk of flooding, it can take many years before their investment on PFR is paid back.

If that cost is reflected in the house insurance products, the insurance company can risk losing its share of the market. It was argued that when buying insurance, people make decisions based on the product's final price and they are less conscious of what they are getting for that price. Additionally, as discussed in Section 6.5.1 the general public usually does not perceive themselves as being vulnerable to flood risk, hence, they are often unwilling to make an extra investment in flood insurance that offers more service (such as resilience repair) in exchange for a higher price. This will negatively affect the sale of the flood insurers and therefore is undesirable. Consequently, this leads to the government and the insurers to have different views on the cost benefits of resilient repair.

Case 3) Flood risk maps and units of risk analysis

Another example that demonstrates the difference between the government and the insurers is the effect of their level of engagement on the data they develop and use. In the context of PLFRD, depending on the level of engagement, the government agencies and members of the insurance industry have developed legacy information systems tailored to the organisation-specific functions which differ from one to another.

Insurers generate data to support their business, which can be very different from that of the EA. Whilst the EA uses mapping data to outline flood risk zone for activities such as planning and flood protection projects, insurers (notably the specialist ones) use such data to adjust the price of their product with the risk they are taking and manage their risk portfolio accordingly. This raises another issue which lies in the differences in their level of engagement in property level flood risk management, which ultimately dictates their unit of risk analysis. The unit of risk analysis for the insurers is the single houses that eventually form their whole risk portfolio, whereas for the EA the smallest unit for risk analysis is the size of the cluster of houses. This changes the value of data on individual properties for the EA.

9.3.1 New actor

Flood Re is one of the key innovations with the opportunity to change the future of use and requisition of PLFRD. It has the opportunity to promote different aspects of PLFRD such as initiating data sharing (Recommendation 8), possibly simpler licensing agreements (Recommendation 12), harmonising claim data (Recommendation 4) and improving evidence for PFR effectiveness (Recommendation 2). Flood Re is still in its early stages of development and thus it is hard to ascertain what its final products at the end of 25 years will be.

Nevertheless, the findings of this study suggest that Flood Re is benefiting from unique characteristics that the 2010 and 2011 reports and their associated initiatives lacked, giving it a privilege in the way that it can benefit PLFRD. Firstly, unlike the aim and objectives of DEFRA 2010, DEFRA 2011 and EA 2011 reports, which were targeted at stakeholders from a variety of backgrounds with disparate interests on PLFRD, Flood Re has crystallised objectives with allocated financial resources and a long-term plan to facilitate the transition of the flood risk insurance market to risk-reflective pricing (Flood Re, 2016). In addition, Flood Re has the advantage of having legislative support. The Water Act 2014 and the subsequent secondary legislation set the legal framework and the broad scope of the regulations within which the scheme operates. None of the recommendations or the incentives had legislative support for implementation before Flood Re. Therefore, Flood Re became a genuine stakeholder for flood risk data at the property level, the only stakeholder with assigned agenda to improve PLFRD.

Secondly, whilst Flood Re is acting as an independent organisation, it is benefitting from the active support of two of the stakeholder groups, not only in the formation but also through the implementation phase. It is supported by financial contributions from the industry; therefore the industry has the interest to see Flood Re being successful. It also has been promoted by the Government through regulatory frameworks. This increases the Government's interest and willingness and continuous support for the scheme's success.

Lastly, Flood Re requires individual insurers to share detailed data for the claims they cede to Flood Re. Therefore, it will hold a valuable data asset. Based on the powers ceded to it, it will have the first national database of properties at high risk of flooding and details of their claim data. This gives the opportunity to use that data to improve the evidence for PFR effectiveness and ease the shortcomings of data sharing and data transfer.

However, alongside the opportunities it can offer, there are possible barriers to creating and using Flood Re datasets that can negatively affect Flood Re's contribution to the PLFRD area. One of the main limitations of Flood Re is its limited lifetime (up to 25 years). This can discourage Flood Re from creating a separate database with a Flood Re label as in absence of Flood Re organisation, managing such a dataset and its ownership will be problematic. There is also a concern that Flood Re will not receive sufficient data, or that the majority of data it receives will be limited to a few numbers of major events.

> *It is predicted that we [Flood Re] will receive only a few thousand claims and those few thousand claims are from a small concentrated number of events, mostly one big event* (Interview, Insurance 5).

ABI also predicted that over time, Flood Re will retain data on 350,000 houses, which is only 2% of the homes at high-risk (ABI, 2018). This is likely to significantly limit the usability of the Flood Re's database since; the impact of flooding on those properties will be very specific to the nature of that flood and the specific characteristics of affected properties. That effect is further influenced by local factors such as the availability of alternative accommodation and the workforce. Therefore, Flood Re's data will be constrained by the extent of flooding in that locality and may not be suitable for generalising the results and extending the findings.

Possible financial concerns and the chance that a catastrophic loss might exhaust the finance pool are other barriers to Flood Re success in creating PLFRD. The findings of this study suggest that amongst some insurers there is a concern with Flood Re that its financial support has limited funders. Flood Re has a central fund in order to pay for the claims that are ceded to it, which comprises of three parts: a primary levy which is paid by all insurers authorised to write home insurance in the UK, the increase announced in the government budget in 2017, and a premium from ceded policies. Flood Re's estimation of the overall liability on the pool suggests that it is unlikely that Flood Re will call for additional contributions in its first 10 years (DEFRA, 2013a). Nevertheless, due to the unpredictable nature of flood claims, the financial performance of a finance pool can vary considerably and the threat of deficit in the later years is not unexpected.

Eventually, considering both benefits and possible limitations of Flood Re and in comparison with the three stakeholder groups discussed in this study, it seems that Flood Re has a unique opportunity to offer as discussed above. However, whilst it can play a momentous role in the development of PLFDR, Flood Re is limited by time and the amount of data it can eventually generate. This calls for assistance and collaboration from other stakeholder groups.

9.4 Rules: the role of business benefit and market competition

The Government needs to make a business case and win the political argument around the fact that it is a good use of public money at any time where there often exist other competing priorities. However, when there are significant time gaps between the large-scale events, flooding will not attract enough attention or funding and will be pushed aside by other pressing demands such as social care and the NHS. For the central government, direct intervention in FRG at property level needs to be seen within the political context and its position amongst the overall priorities. PFR grants are considered to be expensive to taxpayers and therefore, challenging for DEFRA as a civil service to justify PFR funding out of the public budget.

> *With Government cuts in budgets, flood defences will not be to the level that we [the insurers] were expected...The message from the Government basically was that we are continuing to invest but it has to be a move towards protecting yourself* (Interview, Insurance 3).

Between 2007 and 2012 there have been no big flood events of national importance, and consequently, the sum of money paid to cover flood damage in that period was relatively small. Increases in funding tend to surge during and mainly triggered by, flood events, notably 2007, 2013-14 and 2015-16, rather than a consistent long-term approach. This demonstrates that following the effect of economic justification and

ministerial preferences, a strong tendency for the Government's direct intervention at property level flood risk management to be limited to emergency funding.

One of the common concerns of the insurance market was lack of clear and sufficient financial attraction and business benefit in complying with the suggested changes. For example, to incorporate the effect of PFR into the underwriting process or to share their flood extent data, the individual insurers found it difficult to recognise the return benefit to them as discussed in relation to *Incorporating property level protection data into the insurance underwriting* and *Sharing data between ABI and the EA and overcoming the relevant legal obstacles* (recommendations 1 and 8). Similar examples pattern was evident in *Standard damage and claim records for the insurers* (Recommendation 4) and *Developing a tailored report tool to reflect end users' needs* (Recommendation 7) where insurers, notably the bigger companies, find standard damage and claims records to be an unjustifiable investment which can ultimately threaten competitive advantage in the market.

Similarly, financial costs, lack of benefits of a change and market competition were the most common issues suggested by the interviewees. Flood risk is only one of the several risks that insurers need to consider when insuring a house. As explained in Chapter 3, in the UK home insurance, the risk of fire, flood and burglary are bundled. Due to the relatively small size of the unit being insured, flood risk premium fees in home insurance are comparatively marginal to other aspects of insurance (Interview, Insurance 3; Insurance 5; Insurance 6). To minimise the cost and secure the profitability, information is required to be easily obtained and quickly processed. Therefore, the benefit of any action that requires making a change in their current use of data should be enough to not only cover the cost and time required to obtain information and devising methods for using it, but also to ascertain the benefit to the company through, for instance, an increase in utility income received because the information enabled the stakeholder to improve decision making or to increase market share and competitiveness (Recommendation 8) or to build a specific brand.

This difference in the values system of these two stakeholder groups makes defining a common goal in such the multi-actor collaborative process challenging. Such common goal can be produced only through the constant consideration of stakeholders, contribution to collaborate, authorising stakeholders, linking risks and benefits, assigning roles and individualities, ensuring engagement of constituencies, and matching efforts and agreements (Bouwen and Taillieu, 2004). However, such considerations are often overlooked at the cost of concentrating on technical solutions, which can negatively affect the outcomes. Likewise, bringing together the public and private domain is often challenging due to division in their value patterns. For instance, Jacobs (1992, p. 32) defines the public and private domain as two ethical structures with different 'moral syndromes'. Whilst the first one is defined by the guardian characteristics, the latter is characterised by its commercial values. Similarly, Simon (1990) interprets this into a distinction between two types of organisations: task- organisations that follow values such as compliance, the absence of a profit motive and market organisations that are client oriented.

Between the key stakeholders, the absence of dependency on one another's PLFRD for improving their benefits and growth seems to be another barrier towards data exchange and data standardisation. Although some levels of information sharing exist between the stakeholder groups discussed in this study, the absence of common ground in the specification of property level flood risk information dulled the continuous

conversation between the key stakeholders at the property level. Figure 9-1 illustrates the current extent of mutual dependency on detailed data between the key three stakeholder groups, from a generalised view.

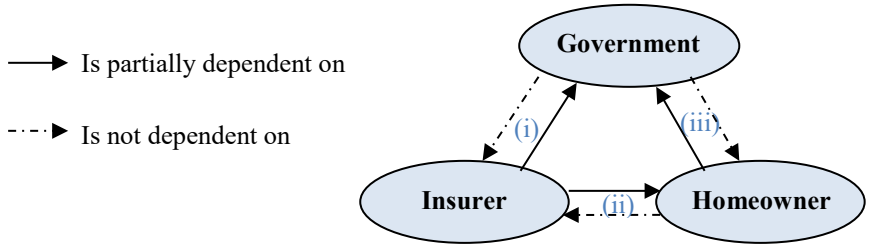

Figure 9-1 Dependency of key stakeholders on other stakeholders' property level data

(i) Following the SoP agreement between the government and the insurance industry (see 3.4.1) the only requirement for mutually beneficial interaction data was for the Government to provide the industry with flood risk and flood defence information. In the later editions of SoP, this requirement stayed unchanged and continued to exist in Flood Re. As a legacy of this agreement, specialised flood insurers have developed their own databases or have subscribed to more detailed commercialised datasets. The Government dependency on insurer information is limited to generalised statistics used to understand the general scope of flood events. No requirements exist for individual insurers to provide the Government with detailed data on flooded properties. These public and private stakeholders carry out their objectives without an urgent obligation to rely on each other's detailed PLFRD.

(ii) Flood insurance partially relies on property owners' information input in the premium setting process. In addition to that, following the significant developments in mapping systems and data provision over the last decade, insurers now can have access to a wide range of datasets including more sophisticated in-house databases and flood risk mapping and models. Thus, the information provided by the individual owners, although important, is often complementary to other sources of information available to the company. It means that they are only partially dependent on the homeowner's information. At the same time, since UK flood insurance is not linked to property risk management, information held by the insurers is rarely shared with homeowners for the purpose of risk mitigation and management. Is similar situation, looking at standardisation of property data with respect to mortgage finance, Markus, Steinfield and Wigand (2006) suggest that the potential adopters of such standardisation of data are uncertain about the costs, benefits, and risks of standards implementation, therefore, each participant is motivated to delay adopting until convinced that others will also adopt.

(iii) The Government's national flood risk management strategies are not dependent on property owners as a source of information. At the local level, there is very limited and inconsistent integration of homeowner's knowledge into local risk management. The property owner can only partially rely on Government data to obtain indicative information about the flood risk. In order to take mitigation action, they are often required to obtain further information from other sources (such as flood surveyors).

Following the historical arrangement and agreements between the insurers and the government, each stakeholder group has gradually grown to become more independent and competent in obtaining data to suit their needs. The only clear routine dependency between stakeholder groups on property level data is the one-way interaction between insurers and the homeowners where insurers use owners' information alongside the other datasets. Consequently, the industry's sale and growth, Government's Flood Risk Management strategies (FRM) or homeowners' decisions are neither linked to nor informed by, the detailed property level data owned by the other stakeholder groups. Markus, Steinfield and Wigand (2006) similarily highlight the importance of considering the extent that actors dependend on borrowing (in this case data) from each other and the level they proceed independently. In the absence of dependency on other groups' existing property level data, when no other incentives or initiatives exist, stakeholders are less keen to follow up and develop such negotiations.

9.5 Reflection on the conceptual framework

In Chapter 4, the developed conceptual framework proposed that the process of flood risk governance at a specific scale is a social process that can be analysed through the interactions between discourse, power, rules and actors coalition. There was no straightforward evidence in the literature that which of the influencing elements are more dominant than others. The findings of this study showed that these changes in the characteristics of these components are stakeholder-driven processes that are highly motivated by political and economic initiatives of the key actor groups.

The most common and effective factor was the change in discourse, that is the ideology of moving toward collaboration and sharing the responsibility that follows the greater theme in the managing flood risk issues. In line with the broader scale of FRG, property level also demonstrates the collaborative characteristic. While evidence found in this study confirms the elements of the conceptual model, the issue found to be far from straightforward in the situation where the role of the market and the private actor's engagement is tied to political and historical presence. Politics and cost-benefit justifications were shown to be the driving forces in the formation of the characteristics of FRG at the property level, resulting in the mix of complex drivers and often conflicts of interest. Therefore, any study of multi-stakeholder risk governance at the property scale is directly linked to the study of both national and local politics and the characteristics of actors that dictate their approach to justifying their participation. Furthermore, the findings have provided insights on what is happening in the context of FRM in England and have shed light on areas that should be considered in order to improve the understanding of the FRG at the scale of property level. Based on the literature, this conceptualisation suggested that changes in FRG at a particular scale can be indicated by characteristics of collaborative governance with a focus on localism scalar arrangement (Pitt, 2008; White, Kingston and Barker, 2010). Hence, the existence and characteristics of these relationships must be acknowledged and understood to fulfil a successful collaborative FRG at such a micro scale that fulfils economic, social, and political goals.

There is a close relationship between discourse, network and coalitions. This research has demonstrated that not only there is an interaction between the components of actors' network and relationships but also they are continuously affected by and interacted through the current discourse. Discourse is understood not to be a

static concept, but rather it can be subject to change and modification throughout time. As similarly suggested by Reed et al. (2009) and Stanghellini (2010) it is not unexpected for the nature of stakeholders' views, requirements and interests at various phases can change over time.

Nonetheless, the focus of this research was specifically placed on shedding light on the relevant components related to the purpose of FRG at the scale of property level. Factors that can instigate this change, as was evident in this study, can include better data provision which provided rescaling the risk management to more granular scale and increases the expectation and accuracy in calculating the risk and related cost-benefit analysis. This can be seen as a result of encouraging the cost-benefit assessment in FRM which was started in the early 2000s (Tunstall, Johnson and Penning-Rowsell, 2004) and further grew by developments in technical methods of data collections and analysis and increase in availability of more detailed flood risk data throughout the years (DEFRA, 2010). This research has shown that change in discourse can affect the central government's approach towards setting the formal/informal rules, but also in the form of actors' response to the new changes.

From an implementation perspective, there is a clear change in the discourse of FRG at the property scale in England. Whilst at this level, the discourse has similar characteristics to the general FRM, as described by Penning-Rowsell and Johnson (2015), there is a stronger presence of the private market as a key actor. The extent of their influence at this scale gives the relative discourse a new dimension. The role of informal rules is forms of norms and values are fashioned based on organisational norms, culture and agreements driving from their political and economic preferences, relationships and agreements. In the absence of formal rules for collaboration at this level, the concept of informal rules can influence actors' behaviour and ultimately affect the success or failure of risk governance at such scale. But the study has gone even further to suggest that in the specific context of risk governance, distinguishing the variety of actors and their characteristics is a prerequisite in the development of meaningful collaboration in a multi-stakeholder sector. In the case of England, politics and economic values, within members of each cluster of stakeholder groups, and incentives justification of actions seems to be the driving force on the process resulting in the involvement of a complex variety of key actors and goals. As suggested by Jacobs (1992), collaborative governance in the existence of two or more different groups with different ethical structure can be complex and challenging. This links the study of property level risk management directly to the careful study of actors' incentives (both to initiate and to continue their involvement in the process) and the key characteristics that dictate their action along the process. This link was demonstrated based on the identified existing values and norms and their definitions of problems and approaches to solutions. Eventually, compatible with the view of Wiering and Immink (2006) and Dieperink et al. (2013), power arrangement is shown to have a reciprocal relationship to both coalitions of key actors and the informal rules.

Lastly, as initially noted in the original conceptualisation, the process of moving toward sharing risk at the property level is rather new and its elements of relationship and network, such as the influence of the new actors and actors' approach are still subject to change and development. Therefore, this process needs careful review and adjustment over time. However, for this study, the focus was specifically placed on how the collection of these complex parts is related to shaping FRM at this particular scale.

9.6 Chapter summary

This chapter presented the discussion of the finding in light of the conceptual framework developed at the early stage of this study. It highlighted the mutual effects of discourse and power on each other and the critical role of diversity of actor, in terms of their drivers and relationships in shaping power and informal rules. To properly develop collaborative flood risk governance at property level effort must take place on engaging the stakeholders at a different stage of this process with an appreciation for their differences and ensuring to include them in the negotiations and the suggested strategies. It was also demonstrated that the processes and mechanisms of risk data collection, data analysis and communication, and how decisions are taken in the form of knowledge governance can be a useful lens in understanding the power and relationships between the actors.

Chapter 10: Conclusion

This chapter summarises the achievements of this research and reflects on the conclusions. It demonstrates that the main aim and objectives of the research have been achieved and the research problem put forward in the first chapter is addressed. The main contribution of this research to the FRM body of knowledge is presented, followed by suggestions for future research directions.

10.1 Addressing the research aim and objectives

In chapter one of this thesis, the research background was presented and the research problem was identified. It was recognised that despite the emphasis on the benefits of the property level flood risk information to a variety of stakeholder groups, such as insurers, government agencies and property owner (DEFRA, 2010), and the corresponding government recommendations in 2010 and 2011(DEFRA, 2010, EA, 2010, DEFRA 2011), there has been no evidence of progress in facilitating property level flood risk data in respect of the needs and requirements of key stakeholders. The primary aim of this research, as specified in Chapter 1 was set out to:

> *"The overall aim of this research is to identify and assess key indicators and critical elements of flood risk governance that create successful risk management at the scale of property level in England from a social and political perspective. It also seeks to characterise more generic implications of multi-sector risk governance at the scale of domestic properties through the lens of use and availability of risk data "*

To achieve the aim of the study, the three following objectives were developed and met.

10.1.1 Objective 1

The first objective of this research was '*to understand and clarify*

a) *Components of flood risk management and their definitions at the property level with the focus on the role of data*
b) *key actors and the evolution of their role in managing risk to individual properties*

Objective 1(a) was addressed in Chapter 2. In relation to this objective, a narrative review of the literature on flood risk management and the role of data was conducted. The outcome of this investigation detailed the drivers of undertaking FRM and its application at the property level. In the extant literature, the effect of flooding on properties is often categorised as tangible and intangible which are then narrowed down to direct and indirect impacts. The risk to single individual properties is subject to the nature of flood, property exposure to flood and vulnerability of the house characterised by the property specifications. These suggested that a change in any of these specifications of risk components can alter the risk to the property. It also highlighted the role of data and stakeholders in delivering FRM strategies.

Objective 1(b) was addressed in Chapter 3. Following on the structure of statuary responsibilities of FRM in the UK, three key stakeholders with influence on PFR were identified. These consisted of Government, insurers and residents. To the extent permitted by the available literature and initial consultation with the key stakeholders, each group was explored with regards to their current state of responsibilities to address the risk to properties and data they use. It was realised that risk management is dominantly based on generalised

flood data (i.e. non-detailed property level data). Despite the evidence of the significance of such data and the recommendation endorsed on DEFRA 2010, DEFRA 2011 and EA 2010 for its improvement, this investigation illustrated the insufficiency of existing evidence to support the improvement on developing and dissemination of property level flood risk data. There is also a lack of explanation regarding factors that might have contributed to this situation.

10.1.2 Objective 2

The next objective of this study was:

> *To develop a conceptual model of the relationship between flood risk governance and scalar arrangement.*

In line with this objective and based on the literature review, a conceptual framework was developed in Chapters 4 combining theories of flood risk governance with the scalar arrangement. Knowledge management was identified as a common measure between risk governance and scalar arrangements. This chapter clarified the type of empirical data to be collected for verification of the conceptual outcome.

Chapter 5, a suitable research methodology was selected and the detailed research strategies for data collection and analysis were explained. Twelve recommendations from the literature were extracted to carry on the evaluation of the existence of current evidence of knowledge management with regards to the property at risk of flood. Empirical data were gathered through in-depth semi-structured interviews with representatives from the three key stakeholder groups.

10.1.3 Objective 3

The third objective was:

> *To identify critical elements that characterise flood risk governance in England at the scale of property level based on in-depth expert interview approach.*

Objective 3 was met in chapters 6, 7 and 8, a summary of with was presented in Table 8-1 and Figure 8-2. Lesson learned from successful and unsuccessful initiatives individually and collectively suggested that political and monetary reasons were the most common factors. Where the interviewees' views on the level of implementation conflict, the researcher drew conclusions on the basis of whether the presented evidence met the outline of the recommendation, and if yes to what extent. Findings suggested that formation of PLFRD recommendations in EA 2010, DEFRA 2010 and DEFRA 2011 reports were massively influenced by the effect of 2007 floods, Pitt Review 2007, determination of the industry to terminate SoP, and the long-running negotiation for the Flood Re agreement.

One of the key findings of this study is that there is a consensus amongst the interviewees that the case for property level flood risk data has current validity. However, in comparison to what was suggested during 2010 and 2011, a number of modifications in the key stakeholders' approach and appetite for such data were observed. Firstly, it seems that performing a universal data collection and dissemination between the government and the insurers faces several obstacles, and there is not enough motivation to pursue it in the form suggested in the recommendations investigated here. Examples are data sharing (Recommendations 8, 9, 10), a harmonised collection of data on loss and damage (Recommendation 4), and standard data

dissemination specific to need of different groups (Recommendation 7). In case of government risk data, the legacy of the top-down information predicated upon constructions of risk has led to a situation where their information and approach are simply not suited to be used by those whom this information is directed to. Similarly, any change in the insurance industry's data activity such as incorporating additional data in their underwriting system (Recommendation1 and 2) and joining an industry-wide data collection method is expected to face individual insurers' rejection. Instead, the focus has shifted towards developing data in the areas where no former data asset existed such as the area of PFRM. Section 8.5 provided a conclusion of this investigation.

10.1.4 Objective 4

To contribute to the evidence based flood risk governance, particularly in the context of multi-sector risk governance at the property level scale.

Objective 4 is partially addressed in final section of Chapter 9 and also will be outlined later in this chapter. Building on the achievements of the previous objectives, a wider implication and possible generalisation of the finding was considered.

10.2 Conclusions

Following the detailed literature review and based on the analysis of the in-depth interviews with expert representatives from the key stakeholder groups and observations; this study has established evidence to support the following key conclusions:

- Multi-sector FRG is subject to an accumulation of different forces including political and market forces and the existence of several stakeholder groups with various levels of interest and power. This led to its complexity. These forces are often interrelated and connected closely. Amongst them, the result of this study suggests financial motives as the most influential.
- The value of PLFRD is different amongst the individual members of stakeholder groups. Not all stakeholders in a particular group or sub-group necessarily shared the same concerns or have unified opinions or priorities. The result of this study suggests that not only there are fundamental differences between the three stakeholder groups, but also dissimilarities between the members of each group were noticeable. Characteristics that widen the data gap between three stakeholder groups discussed in this study are: (i) their definition of what is cost and what is benefit, (ii) unit of analysis, (iii) level of engagement, (v) different purpose for using PLFRD which ultimately affects the value they put on detailed property level data and creates a disparate mix of PLFRD end-users. It seems that any negotiations with such a disparate and vast group of stakeholders would fail unless a robust motive exists to trigger some form of consensus for standardisation and consistency of data.
- A gradual shift in the role of the Government approach towards property level flood risk management was observed. The Government is taking the role of an enabling force instead of a paternalistic approach. It supported and funded technologies to encourage self-reliance in managing risk to individual properties in two ways. Firstly, to test and initiate the accountability of property level flood risk management technologies such as PFR in order to produce evidence for the reliability of these technologies. Secondly, it provided an opportunity for cost and benefit analysis of

such technologies to the property owners and thus helps to create a favourable economic environment. The reduction in the Government's intervention was replaced by freedom of choice in mitigating strategies for the insurer and the homeowner.

- The individual ability and freedom of choice of protection measures based on individual taste through the free market, as opposed to formation of standards through consistent and universal norms, requires insurers and homeowners to develop the ability to make informed decisions and estimate their risk based on cost-benefit analysis of the available options rather than through state intervention.
- The idea of increasing the autonomy and the responsibility of the homeowners to maximise their protection against the risk is growing. This encourages an informed and responsible choice, knowing that their choice has a direct effect on their level of risk and consequences of a flood event. They are expected to actively participate in the protection of their properties through options available on the free market. Options include shopping around in the flood insurance market to secure financial support and seeking information and opportunities available through PFR.
- Results of this study suggest the existence of a strong logic of cost-benefit accountability steering the relationship between the stakeholders. Owing to the developments in mapping technologies and data analysis, stakeholders gain the ability to use this risk data in a cost-benefit analysis. Through this analysis, the evaluation and scrutiny of options and decisions are made possible for the three stakeholder groups. This provides further emphasis on the need for the availability of data that can support such decisions.

In summary, these conclusions suggest that following the approach adopted in DEFRA 2010, DEFRA 2011 and EA 2010 a practical implementation of PLFRD seems unrealistic. Findings suggest that there exist some conflicting views amongst the key stakeholder group, which reflect the different characteristics of these groups. However, indications and opportunities including government prompting for an informed risk-based approach towards FRM, autonomous risk mitigation for those at risk, and the opportunities that lie within Flood Re indicate that there is a prospect for PLFRD to be enhanced in the future.

10.3 Contribution to knowledge

This research has provided new analysis into the feasibility of moving toward property level flood risk data. It appraised the opportunities and barriers to use of property level flood risk data in respect of the requirements of key stakeholders. The main contributions of this research to practice and knowledge comprises as follows:

10.3.1 Conceptual contributions

This developed a theoretical framework and application to the complex diverse stakeholder-driven policy area; its exploratory and inductive nature expand this area of study by concentrating on the challenges of FRG at the scale of individual property on the specific context of England. It also concludes a number of generalised themes that can be applied to similar multi-stakeholder and multi-sector activities in environmental risk management as well as contributing insight into the use of collaborative knowledge management as a theoretical lens to explore multi-sector collaboration in the context of risk governance.

It further reflects the important role of having a clear understanding of the key actors' perspective in collaborative governance and highlight the need to explore the micro level risk governance based on not only the characteristics of the cluster of key stakeholders as a groups, but also understanding the varieties that exists between the members of the coalitions.

10.3.2 Practical and policy contribution

While findings clearly demonstrate a change in state traditional approach to managing flood risk at property scale, via seeking re-arranging the roles and responsibilities between the key actors, however, due to the level of the organisational and political complexity of the matter there was a delay on development of a systematic arrangement to this new setting. On a practical level, findings of this thesis help to improve understanding of flood risk management at the scale of property by presenting insight into the characteristics of actors and their approaches towards multi-disciplinary risk management. It identifies and classifies the key influential factors in the implementation of changes and modification of FRG and improvement of the data management amongst the key actors. The most critical area address here is the new settings in the power and roles of the key actors.

This also raises the implementation challenge regarding collaboration efforts such as knowledge and risk management. In that regards this research offered insight into the key stakeholders' characteristics that influence and explain their contribution and behaviours and provide bases to predict their participation in the application of future proposals for change. Through identifying the primary forces through which the success or failure of a multi-stakeholder recommendation can be expected.

The policy contribution of this thesis is the conceptualisation and operationalisation of the multi-sector flood risk governance at the scale of property which can have an impact on future risk mitigation strategies. The significance of this study is linking the multi-sector FRG with at the particular scale of individual properties in a structured framework that was specifically developed to analyse the critical factors involved in FRG at the scale of individual properties in England. This research is adding value to the existing literature through novel integration and testing of two different distinct areas of knowledge through a conceptual framework that is otherwise studied separately.

10.4 Limitations and generalisation

In this study, the data collection and analysis was based on knowledge gathered from 15 in-depth interviews with experts, selected from three key stakeholder groups. This selection was dominantly made from those who were understood to be informative influential individuals in the area of wider collaborative knowledge management and risk governance. These views can be further extended by including those who have not actively contributed to this participation or stakeholders or member of the groups who adopted a more neutral position towards this subject. With the accumulation of larger diversity of stakeholders, within the main three groups and outside of it, it is possible to obtain a wider and more informative view of actors' perspectives and characteristics.

It can be argued that the finding might be based on a personal view of the participant and might not reflect the true reality of the topic. The counter-argument to that their judgment is shaped by their experience of

communicating with other actors and contributing to the formation of the present state of the topic over the years. Hence, the collected data not only is a reflection of their insight but also their experience in the matter with makes the final verification of the initial conceptualisation that was based on the literature credible.

This study was a constraint in a timeframe hence could provide a snapshot of the conceptual finding. Following the new consistent roundtable dialogues between the actors (initiated under DEFRA property level flood resilience roundtable 2016-2021), it is plausible that if this research is replicated, findings will offer further clarifications and insight to actors' incentives and motivations, and similarly, new relationships and arrangements may be concluded. It should be noted that it does not underestimate the finding of this research as the outcomes have proved a starting point for further investigation.

It is also important to note that this study used the opportunity of previous recommendation as a basis to explore different aspects of knowledge management and which can be used to explore different aspects of risk governance. Although using knowledge governance proved to be a useful lens in the unique circumstances of this study, its generalisation may seem limited. Firstly, this research reveals that knowledge controversies are far from being seen as 'universal'. Risk data and information proved to be highly malleable concepts appropriated for particular uses in particular debates. Secondly, the successful application of this approach was dependent on the presence of requirements at international (EU) and also a national recommendation and historical settings requiring such collaboration through knowledge management it that allows for and encourages. Therefore, in a governance setting where such pre-existing developments and initiatives in collaborative knowledge management do not exist, the practicality of this lens is less relevant.

10.5 Scope for future research

This research provided the first step in identifying the key influential factors to this topic to the extent that the limitation of this study (as noted above) permitted. This leaves a number of future research opportunities that could not be addressed within the scope of this study.

- **Extending the results to wider stakeholder groups**

In this research, the process of data collection and analysis was designed to reflect the view of three key stakeholder groups. While the views of these groups were accounted for here, it was concluded that the future of property level flood risk mitigation strategies can be influenced by lobbyist groups with business interests. A full assessment of the market for such data requires a wide range of possible end-users of PLFRD to be considered. Amongst them are construction communities and fast-growing PFR products supplier companies. There is scope for further study on:

(i) the potential role they have in providing data on the installed measures (e.g. what was installed, when, how and to what standard),
(ii) their capacity to link the government strategies and homeowner's activity
(iii) the extent that their relationship with the three key stakeholder groups can be supported and what are the potential areas for improvement.

- **Further exploration of a variety of characteristics of homeowners that can help to understand their need for data, and financial mechanism to meet that need**

This study was conducted at the policy level. This limited the selection of community candidates for interview who could both deliver a relatively none restricted view of this group and also be informant enough at the policy level. The main reason was that the concept of community and individuals systematic engagement in FRM is fairly young, and the views and experience of the existing candidates often were constrained by the scope of their time and location of flood they have been exposed to, therefore, they often could offer only limited or no insights into the gradual shift that was happening in the FRM policy and recommendation under investigation. This study identified some of the characteristics that distinguish property owners from the other two stakeholders; future studies should investigate these characteristics in more detail. Following the incentives noted in section 6.5, it is expected that in the future there will be more grassroots representatives who can provide more confident views which will provide opportunities for further analysis.

- **Exploring the business opportunities options to increase market engagement**

This research identified business opportunities as a key factor in increasing market engagement in the implementation of recommendations. Future studies should explore options and prospects that can trigger business opportunities. They should also investigate the benefits and risks of the possible options to the individual property owners.

- **Exploring areas where stakeholders can assist Flood Re in generating PLFRD**

Flood Re was identified as a key opportunity which could influence the future of PLFRD use and availability. However, it requires contributions and ongoing support from other stakeholders groups. Areas and possible extent of this contribution require detailed investigation and is proposed as a future research area.

- **Consideration of technology opportunities**

Findings of this study suggested that a strong current case for PLFRD exists; however, the value of such data can have a different value for different stakeholder groups. Future studies should consider categorising whether the existing range of PLFRD can be categorised based on their value across the key stakeholder groups. If yes, investigations on the technical viability of a platform that such data can be hosted and easily expanded will be needed.

PhD reflections

This has been a unique 3 and a half years of my life during which shed new light in my sense of identity and brought radical change in my worldview. I have started this programme with a fixed idea to explore the data on the area of property level flood risk management. The intention was to develop a prototype database that can host data describing the flood characteristics and building specification. The aim was to facilitate harmonised collection and use of property level flood risk data. Given the different and unique characteristics of data describing flood and property, I decided that an integrated method of Building Information Modelling with Geographic Information System would be a promising solution. Therefore, I passionately invested my time to develop my skills in that area and investigated the integration options. I pursued this aim for the first year of my study. However, the more I narrowed down my study and the suggested technical solution, the harder it was to take no account of a new parallel gap, and perhaps a more fundamental one, unveiling in the topic under study. Despite the numerous theoretical benefits of such a database, I was not convinced whether there is a case for harmonised property level flood risk data that can be used by the putative stakeholder groups. I decided to address this gap as it seemed to me as a more immediate gap. Therefore, whilst remaining faithful to the main area of the research i.e. data and property level flood risk, I needed to replan the path of study from quantitative to qualitative. It was a hard decision for me. But in the end, the result of a new path was rewarding and reassured me that it was the right choice. This taught me that research should not be considered as a solid predetermined path but a dynamic, intelligent and open journey. This taught me flexibility in the face of changing circumstances and openness in research. It instigates the first step toward what later grew to become a sense of responsibility in the research I conduct.

I found the fieldwork to be a very interesting part of the research process. I mainly owe it to the privilege of meeting experts who were amongst the best and most successful members of the groups they were representing. Their interest and level of engagement in this study was beyond my expectations and inspiring. I went to the field to work with the presumption that risk data is a sensitive topic and not every stakeholder might be willing to discuss it openly. However, the interviewees' stimulating and positive attitude towards my study was most engaging.

However, it was not until the analysis and writing up that I started to imitate the scene of a true researcher and practice the critical viewing in its true sense. The diversity of views and the expanse of suggested influencing factors made the process of prioritising, criticizing and comparison challenging at the beginning. I have tried different methods for coding, labelling and analysing the collected data. For a while, I made it my goal to make the Nvivo programme work for me. I took training courses and watched tutorial videos. But soon I realised that it is not a suitable tool for specific data I had in hand. Instead, I switched to the more traditional methods such as manual and digital mind mapping tools (such as Lucidchart) alongside using tables and diagrams. I found the practice of critical viewing

This was the stage I realised the importance of keeping the aim and research objectives in focus when writing the different chapters. This has helped me to avoid too much drifting. During the process of writing I have had to revise my thesis outline, and on occasions adjusted the statement of the problem. This, no doubt came

as a result of constant learnings that were obtained from exposure to other researcher works, data analysis process, and preparation of several drafts of each chapter.

In developing ideas, I learned the value of sharing thoughts alongside the importance of having time to think alone and work alone. This experience was enhanced by having the unique opportunity from my supervisor to have my desk located alongside one of the most accredited research groups at Oxford Brookes University at the time. Eventually, looking back at this study, I came to the acceptance that reality is relative and context-based. This will not be the end of my journey. I look forward to extending my experience into the field of natural risk management and data and put my findings and learnings into practice in my future roles.

References

Abbott, M. (2007) 'Stakeholder participation in creating infrastructure', *New Civil Engineer,* 160(1), pp. 26-32.

Abdullah, R.*, et al.* (2007) 'Developing Knowledge Management System for Public Higher Learning in Collaborative Environment', *International Journal of Computer Science and Network Security,* 7(7), pp. 331-41.

ABI (2004) 'A Changing Climate for Insurance A Summary Report for Chief Executives and Policymakers'.

ABI (2009) 'Resilient and reinstatement: The costs of flood resilient reinstatement of domestic properties'. London.

ABI (2012) *A guide to resistant and resilient repair after a flood*Available at: https://www.abi.org.uk/Insurance-and-savings/Topics-and-issues/~/media/0837E8F0B35147D59A92D0A7231A572F.ashx (Accessed: 08 June 2015).

ABI (2013) *Written evidence to the Environment, Food and Rural Affairs Select Committee inquiry into flood funding*Available at: http://www.publications.parliament.uk/pa/cm201213/cmselect/cmenvfru/writev/flood/m07.htm.

ABI (2014a) *About ABI*Available at: https://www.abi.org.uk/About (Accessed: 28 November 2014).

ABI (2014b) *Flooding*Available at: https://www.abi.org.uk/Insurance-and-savings/Topics-and-issues/Flooding (Accessed: 18 February 2015).

ABI (2015) *Average quarterly household insurance premium tracker: Cost of home insurance continues to fall*Available at: https://www.abi.org.uk/News/News-releases/2015/04/Quarterly-Average-Household-Premium-Tracker-Cost-of-home-insurance-continues-to-fall.

ABI (2016) *New figures reveal scale of insurance response after recent floods*Available at: https://www.abi.org.uk/News/News-releases/2016/01/New-figures-reveal-scale-of-insurance-response-after-recent-floods (Accessed: 10 February 2016).

ABI (2018) *Flood Re explained*Available at: https://www.abi.org.uk/products-and-issues/topics-and-issues/flood-re/flood-re-explained/ (Accessed: 23 January 2018).

ABI (no date) *The Insurance Industry's role in responding to major events*Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/60526/abi-surge-plan.pdf (Accessed: 21 May 2015).

Adaptation Sub-Committee (2012) *Climate change – is the UK preparing for flooding and water scarcity?*: Committee on Climate Change.

Alexander, D. (1991) 'Natural disasters: a framework for research and teaching', *Disasters,* 15(3), pp. 209-226.

Alexander, M. (2013) *Constructions of flood vulnerability across an etic-emic spectrum* PhD thesis. Middlesex University.

Alexander, M., Priest, S. and Mees, H. (2016) 'A framework for evaluating flood risk governance', *Environmental Science & Policy,* 64, pp. 38-47.

Amirebrahimi, S. (2016) *A framework for micro level assessment and 3D visualisation of flood damage to a building.*

Andrews, C. J. (2006) 'Rationality in policy decision making', *Handbook of Public Policy Analysis*: Routledge, pp. 187-198.

Apthorpe, R. and Gasper, D. (2014) 'Introduction: Discourse analysis and policy discourse', *Arguing Development Policy*: Routledge, pp. 7-21.

Arts, B., Leroy, P. and Van Tatenhove, J. (2006) 'Political modernisation and policy arrangements: a framework for understanding environmental policy change', *Public organization review,* 6(2), pp. 93-106.

Ashworth, R., Snape, S. and Aulakh, S. (2007) 'Plugging the accountability gap? Evaluating the effectiveness of regional scrutiny', *Environment and Planning C: Government and Policy,* 25(2), pp. 194-211.

Audit commission (2007) *Improving information to support decision making: standards for better quality data, A framework to support improvement in data quality in the public sector.* London.

Aviva (2002) *UK Revolutionary digital map commissioned to pinpoint flood risk*Available at: https://www.aviva.com/newsroom/news-releases/2002/03/uk-revolutionary-digital-map-commissioned-to-pinpoint-flood-risk-1118/ (Accessed: 28 May 2015).

Aviva (2004a) *Norwich Union's revolutionary flood map begins roll-out*Available at: http://www.aviva.co.uk/media-centre/story/1684/norwich-unions-revolutionary-flood-map-begins-roll/ (Accessed: 8 August 2015).

Aviva (2004b) 'The Flood Mapping Project'.

Bakker, K. (2005) 'Neoliberalizing nature? Market environmentalism in water supply in England and Wales', *Annals of the association of American Geographers,* 95(3), pp. 542-565.

Barford, V. (2012) 'Why do people buy houses in places prone to flooding?', *BBC News Magazine*. Available at: http://www.bbc.co.uk/news/magazine-20528352.
Becker, A. B., Johnstone, W. M. and Lence, B. J. (2010) 'Wood frame building response to rapid-onset flooding', *Natural Hazards Review,* 12(2), pp. 85-95.
Beddoes, D. W. and Booth, C. (2011) 'Property level flood adaptation measures: a novel approach', *International Journal of Safety and Security Engineering,* 1(2), pp. 162-181.
Beierle, T. C. (2002) 'The quality of stakeholder-based decisions', *Risk Analysis: An International Journal,* 22(4), pp. 739-749.
Bennett, O. and Edmonds, T., House of Commons (2014) *Household flood insurance*.
Berkes, F. (2007) 'Understanding uncertainty and reducing vulnerability: lessons from resilience thinking', *Natural hazards,* 41(2), pp. 283-295.
Bevir, M., Rhodes, R. A. and Weller, P. (2003) 'Traditions of governance: interpreting the changing role of the public sector', *Public administration,* 81(1), pp. 1-17.
Bhanumurthy, V. and Behera, G. (2008) 'Deliverables from space data sets for disaster management–present and future trends', *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences,* 37, pp. 263-270.
Bin, O.*, et al.* (2008) 'Flood prone with a view: coastal housing market response to risk and amenity', *Land Economics,* 84, pp. 434-48.
Blaikie, P.*, et al.* (2014) *At risk: natural hazards, people's vulnerability and disasters.* Routledge.
Blok, A., Jensen, M. and Kaltoft, P. (2008) 'Social identities and risk: expert and lay imaginations on pesticide use', *Public understanding of science,* 17(2), pp. 189-209.
Botzen, W. J. and Van Den Bergh, J. C. (2008) 'Insurance against climate change and flooding in the Netherlands: present, future, and comparison with other countries', *Risk analysis,* 28(2), pp. 413-426.
Bouwen, R. and Taillieu, T. (2004) 'Multi-party collaboration as social learning for interdependence: Developing relational knowing for sustainable natural resource management', *Journal of community & applied social psychology,* 14(3), pp. 137-153.
bre.co.uk (2015) *Property Flood Resilience Database Project (PFR-d)* Available at: http://www.cila.co.uk/files/BRE/92785%20Property%20Flood%20Resilience%20Database%20Invite%20v1.pdf (Accessed: 20 September 2015).
bre.co.uk (2017) *Property Flood Resilience Surveyors training course*Available at: https://www.bre.co.uk/eventdetails.jsp?id=15540 (Accessed: 14 December 2017).
Brenner, N. (1997) 'State territorial restructuring and the production of spatial scale: urban and regional planning in the Federal Republic of Germany, 1960–1990', *Political geography,* 16(4), pp. 273-306.
Brenner, N. (2001) 'The limits to scale? Methodological reflections on scalar structuration', *Progress in human geography,* 25(4), pp. 591-614.
Brenner, N. (2004) 'New state spaces: urban governance and the rescaling of statehood,' *Oxford University Press Publication,* 62(2), pp. 95-98.
Brown, C.*, et al.* (2012) 'Decision scaling: Linking bottom-up vulnerability analysis with climate projections in the water sector', *Water Resources Research,* 48(9).
Brown, J. C. and Purcell, M. (2005) 'There's nothing inherent about scale: political ecology, the local trap, and the politics of development in the Brazilian Amazon', *Geoforum,* 36(5), pp. 607-624.
Brown, J. D. and Damery, S. L. (2002) 'Managing flood risk in the UK: towards an integration of social and technical perspectives', *Transactions of the Institute of British Geographers,* 27(4), pp. 412-426.
Bryman, A. (2012) *Social research methods.* 4th edn. New York: Oxford University Press.
Burns, N. and Grove, S. (1997) *The Practice of Nursing Research: Conduct, Critique and Utilization.* 3rd edn. Philadelphia: WB Saunders Company.
Burrell, G. and Morgan, G. (2005) *Sociological paradigms and organisational analysis: Elements of the sociology of corporate life.* Ashgate.
Cabinet Office (2016) *Resilience direct*Available at: http://www.emcouncils.gov.uk/write/Resilience_Direct_Presentation.pdf (Accessed: 30 Mar 2017).
Carter, J. and Howe, J. (2006) 'Stakeholder participation and the water framework directive: The case of the Ribble Pilot', *Local environment,* 11(02), pp. 217-231.
Castree, N. (2008) 'Neoliberalising nature: the logics of deregulation and reregulation', *Environment and planning A,* 40(1), pp. 131-152.
Charmaz, K. (2014) *Constructing grounded theory.* Sage.
Charreaux, G. (2004) 'Corporate governance theories: From micro theories to national systems theories'.
Christophers, B. (2019) 'The allusive market: insurance of flood risk in neoliberal Britain', *Economy and Society*, pp. 1-29.
Cohen, L., Manion, L. and Morrison, K. (2007) *Research methods in education.* London: Routledge.

Collins, H. M. and Evans, R. (2002) 'The third wave of science studies: Studies of expertise and experience', *Social studies of science,* 32(2), pp. 235-296.
Competition Act, 1998.
Cornell, S. (2006) *Improving stakeholder engagement in flood risk management decision making and delivery.* Bristol: Environment Agency.
Cosgrove, W. and Rijsberman, F. (2000) 'World water vision: Making water everybody‟ s business, World Water Council, World Water Vision, and Earthscan', *London, UK*.
Cowley, R., Ley, S. and Whitlow, H. (2002) *UK household: floods, inflation and under-insurance. Working party report*Available at: http://www.actuaries.org.uk/research-and-resources/documents/uk-household-floods-inflation-and-under-insurance-working-party-rep.
Cox, K. R. (2013) 'Territory, scale, and why capitalism matters', *Territory, Politics, Governance,* 1(1), pp. 46-61.
Data.gov.uk (2017) *National Receptor Dataset (AfA171)* Environment AgencyAvailable at: https://data.gov.uk/dataset/national-receptor-dataset-afa171 (Accessed: 14 March 2018).
Davies, A. (2002) 'Power, politics and networks: shaping partnerships for sustainable communities', *Area,* 34(2), pp. 190-203.
Davoudi, S. and Evans, N. (2005) 'The challenge of governance in regional waste planning', *Environment and Planning C: Government and Policy,* 23(4), pp. 493-517.
DCLG, Government, D.f.C.a.L. (2007) *Improving the Flood Performance of New Buildings: Flood Resilient Construction.* London.
DCLG (2010) *Guidance and standards for drying flood damaged buildings: BD2760.* London.
DCLG (2011) *A plain English guide to the Localism Act*.
DCLG (2016) *Land Use Change Statistics in England: 2014-15*.
De Marchi, B. (2003) 'Public participation and risk governance', *Science and Public Policy,* 30(3), pp. 171-176.
de Moel, H. and Aerts, J. (2011) 'Effect of uncertainty in land use, damage models and inundation depth on flood damage estimates', *Natural Hazards,* 58(1), pp. 407-425.
de Moel, H.*, et al.* (2015) 'Flood risk assessments at different spatial scales', *Mitigation and Adaptation Strategies for Global Change,* 20(6), pp. 865-890.
DEFRA (2000) *Guidelines for Environmental Risk Assessment and Management: Revised Departmental Guidance*: London: The Stationery Office.
DEFRA (2004) *Making Space for Water. Developing a New Government Strategy for Flood and Coastal Erosion Risk Management in England: A Consultation Exercise*.
DEFRA (2008) *Developing the evidence base for flood resistance and resilience: Summary Report*.
DEFRA (2009a) *Adapting to climate change UK Climate Projections.* London.
DEFRA (2009b) *Draft Flood and Water Management Bill, Consultation Paper*.
Environmental Protection: The Flood Risk Regulations 2009 (3042).
DEFRA (2009d) *Summary of Responses to the Consultation on the Draft Flood and Water Management Bill from 21 April 2009–24 July 2009.* London.
DEFRA (2010) *Availability and Uses of Property Level Flood Risk Data and Information. Technical Report FD2637/TR Final Report* London.
DEFRA (2011a) *Flood and Coastal Resilience Partnership Funding*.
DEFRA (2011b) *Flood risk and insurance: A roadmap to 2013 and beyond_Final report of the flood insurance working groups*Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69467/pb13684-flood-risk-insurance.pdf (Accessed: 9 February 2015).
DEFRA (2012a) *Climate Change Risk Assessment for the Floods and Coastal Erosion Sector*Available at: https://www.gov.**uk**/.../uploads/.../pb13698-**climate-risk-assessment**.pdf (Accessed: 21 September 2015).
DEFRA (2012b) *Establishing the Cost Effectiveness of Property Flood Protection: FD2657 Final Report.* London: JBA.
DEFRA (2012c) *The Government's Response to Sir Michael Pitt's Review of the summer 2007 Floods Final Progress Report.* London.
DEFRA (2013a) *Managing the future financial risk of flooding*.
DEFRA (2013b) *Securing the future availability and affordability of home insurance in areas of flood risk*
DEFRA (2014) *Post-Installation Effectiveness of Property Level Flood Protection, final report FD2668*.
DEFRA (2015) *Surveying for Flood Resilience in Individual Properties FD2681*
DEFRA (2016a) *National Flood Resilience Review: Government action to tackle floods. Press Release, 26th January 2016*
DEFRA (2016b) *The property flood resilience action plan*.

DEFRA (2017) *Evaluation of the arrangements for managing local flood risk in England_FD2680.* London.
DEFRA and EA (2007) *Improving data and knowledge management for effective integrated FCERM, R&D technical report FD2323/TR1*.
DEFRA and EA (2008a) *Developing the evidence base for flood resistance and resilience summary report*: DEFRA.
DEFRA and EA (2008b) *Developing the evidence base for flood resistance and resilience: Summary Report*.
DEFRA and EA (2006a) *Flood Risks to People Phase 2, FD2321/TR2 Guidance Document.* London.
DEFRA and EA (2006b) *Improving stakeholder engagement in flood risk management decision making and delivery*.
DEFRA and EA (2014a) *Framework and tools for local flood risk assessment: project report SC070059/R3*.
DEFRA and EA (2014b) *Guidance: Flood risk assessment for planning applications*Available at: https://www.gov.uk/guidance/flood-risk-assessment-for-planning-applications (Accessed: 10 June 2016).
DEFRA and EA (2014c) *The National Flood Emergency Framework for England.* London.
DEFRA and LGA (2008) *Survey of Local Flood Risk Management.* London.
Dewulf, A., Craps, M. and Dercon, G. (2004) 'How issues get framed and reframed when different communities meet: a multi-level analysis of a collaborative soil conservation initiative in the Ecuadorian Andes', *Journal of Community & Applied Social Psychology,* 14(3), pp. 177-192.
Dicke, W. and Meijerink, S. 2008. The Public-Private Divide in Flood Management. Taylor & Francis.
Donaldson, A.*, et al.* (2013) 'Overflowing with issues: following the political trajectories of flooding', *Environment and Planning C: Government and Policy,* 31(4), pp. 603-618.
Donnelly, W. A. (1989) 'Hedonic price analysis of the effect of a floodplain on property values', *JAWRA Journal of the American Water Resources Association,* 25(3), pp. 581-586.
Dore, J. and Lebel, L. (2010) 'Deliberation and scale in Mekong Region water governance', *Environmental Management,* 46(1), pp. 60-80.
Douben, N. and Ratnayake, R. 'Characteristic data on river floods and flooding; facts and figures'. *J. Van Alphen, E. Van Beek, and M. Taal (edn.), Floods, from Defence to Management, Third International Symposium on Flood Defence*, 19-35.
Driessen, P. P.*, et al.* (2012) 'Towards a conceptual framework for the study of shifts in modes of environmental governance–experiences from the Netherlands', *Environmental policy and governance,* 22(3), pp. 143-160.
Driscoll, C. and Starik, M. (2004) 'The primordial stakeholder: Advancing the conceptual consideration of stakeholder status for the natural environment', *Journal of business ethics,* 49(1), pp. 55-73.
Dutta, D. and Herath, S. 'GIS based flood loss estimation modeling in Japan'. *Proceedings of the US-Japan 1st workshop on comparative study on urban disaster management*, 151-161.
EA (2003) *Strategy for Flood Risk Management 2003–2008 Version 1.2.* Bristol.
EA (2005a) *Improving community and citizen engagement in flood risk management decision making, delivery and flood response, R&D Technical Report SC040033/SR3.* Bristol.
EA (2005b) *The impact of flooding on urbanand rural communities: R&D Technical Report*.
EA (2009a) *Flooding in England: A national assessment of flood risk*.
EA (2009b) *Flooding in England: A National Assessment of Flood Risk*Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/292928/geho0609bqds-e-e.pdf (Accessed: 24/11).
EA (2010a) *Flood and Coastal Risk Management Risk Mapping Strategy 2010–2015*.
EA (2010b) *The costs of the summer 2007 floods in England- Project: SC070039/R1.* Bristol, England.
EA (2012) *Property flood protection: flood risk report*Available at: https://www.gov.uk/government/publications/property-flood-protection-flood-risk-report%20.
EA (2015a) *Preparing for flooding A guide for sites regulated under EPR and COMAH*.
EA (2015b) *Public dialogues on flood risk communication*.
EA (2018a) *Estimating the economic costs of the 2015 to 2016 winter floods*.
EA (2018b) *Learn more about flood risk*Available at: https://flood-warning-information.service.gov.uk/long-term-flood-risk/map (Accessed: 28 November 2018).
EEA (2011) 'Mapping the impacts of natural hazards and technological accidents in Europe: An overview of the last decade EEA Technical report No 13/2010, 2011'.
EEA (2012) 'Climate change, impacts and vulnerability in Europe 2012: An indicator-based report'. Available at: http://www.eea.europa.eu//publications/climate-impacts-and-vulnerability-2012.
Elliott, D. (2001) 'Risk governance: is consensus a con?', *Science as Culture,* 10(2), pp. 265-271.
Elmer, F.*, et al.* 'HOWAS21–Conceptual framework and configuration of an object specific flood damage database for Germany'. *Forum DKKV/CEDIM: Disaster Reduction in Climate Change*.

Eraut, M. (2005) 'Expert and expertise: meanings and perspectives', *Learning in Health and Social Care,* 4(4), pp. 173-179.
Escarameia, M., Karanxha, A. and Tagg, A. (2006) 'Improving the flood resilience of buildings through improved materials, methods and details. DCLG Building Regulations (Sanitation) Framework', *Work Package*.
Escarameia, M.*, et al.* (2012) 'The role of building materials in improved flood resilience and routes for implementation', *The 2nd European Conference on Flood Risk Management*. Rotterdam, pp.
Evans, E.*, et al.*, Technology, O.o.S.a. (2004) *Foresight. Future flooding. Scientific summary: Volume 1—future risks and their drivers.* London
Eves, C. (2004) 'The impact of flooding on residential property buyer behaviour: an England and Australian comparison of flood affected property', *Structural Survey,* 22(2), pp. 84-94.
Fainstein, S. S. (1999) 'Power and geographic scale: comments on Morrill', *Political Geography,* 18(1), pp. 39-43.
Fischer, F. (2007) 'Deliberative policy analysis as practical reason: Integrating empirical and normative arguments', *Handbook of public policy analysis: theory, politics, and methods*, pp. 223-236.
Fischer, F. (2009) *Democracy and expertise: Reorienting policy inquiry.* Oxford University Press.
Flick, U. (2014) *An introduction to qualitative research.* Sage.
Flood Re (2016) 'Transitioning to an affordable market for household flood insurance, The first Flood Re transition plan'.
Flood Repairs Forum (2006) *Repairing flooded buildings: an insurance industry guide to investigation and repair* Watford, UK: BRE Press.
Flood-warning-information.service.gov.uk. (2017) *Long Term Flood Risk Information* Available at: https://flood-warning-information.service.gov.uk/long-term-flood-risk/map?easting=461510&northing=191574&address=100120883818 (Accessed: 29 March 2017).
Flyvbjerg, B. (1998) *Rationality and power: Democracy in practice.* University of Chicago press.
Foss, N. J. and Mahoney, J. T. (2010) 'Exploring knowledge governance', *International Journal of Strategic Change Management,* 2(2-3), pp. 93-101.
Foss, N. J. and Michailova, S. (2009) *Knowledge governance: Processes and perspectives.* Oxford University Press.
Gardoni, P. and Murphy, C. (2014) 'A scale of risk', *Risk Analysis,* 34(7), pp. 1208-1227.
Garrick, D. and Hall, J. W. (2014) 'Water security and society: risks, metrics, and pathways', *Annual Review of Environment and Resources,* 39, pp. 611-639.
Garvin, S.*, et al.* (2016) 'Property flood resilience database: an innovative response for the insurance market', *FLOODrisk 2016 - 3rd European Conference on Flood Risk Management*. Lyon, France, pp. 1-6.
Gaventa, J. (2004) 'Representation, community leadership and participation: citizen involvement in neighbourhood renewal and local governance', *Report, Neighbourhood Renewal Unit, Office of Deputy Prime Minister, July, 04.*
gov.uk (2017) *Find out if you're at risk of flooding*Available at: https://www.gov.uk/check-flood-risk (Accessed: 20 March 2017).
Government Office for Science (2004) *Future flooding scientific summary: volume 2 - managing future risks*.
Granger, K. (1999) 'Understanding multi-hazard risk in urban communities', *Proceedings of Disaster Prevention for the 21st Century, Emergency Management*.
Grant, Z., Gillibrand, K. and Hendel-Blackford, S. (2011) 'Research to Identify Potential Low-Regrets Adaptation Options to Climate Change in the Residential Buildings Sector', *David Langdon (AECOM), London*.
Green, C. and Penning-Rowsell, E. (2004) 'Flood insurance and government:'Parasitic'and'Symbiotic'relations', *The Geneva Papers on Risk and Insurance-Issues and Practice,* 29(3), pp. 518-539.
Green, C. and Penning-Rowsell, E. C. (2010) 'Stakeholder engagement in flood risk management', *Flood risk science and management*, pp. 372-385.
Green, C., Viavattene, C. and Thompson, P. (2011) 'Guidance for assessing flood losses', *Guidance for assessing flood losses*: CONHAZ Consortium.
Grix, J. (2004) *The foundations of research.* London: Palgrave Macmillan.
Grix, J. and Phillpots, L. (2011) 'Revisiting the 'Governance Narrative' 'Asymmetrical Network Governance'and the Deviant Case of the Sports Policy Sector', *Public policy and administration,* 26(1), pp. 3-19.
Haigh, N. and Griffiths, A. (2009) 'The natural environment as a primary stakeholder: the case of climate change', *Business Strategy and the Environment,* 18(6), pp. 347-359.
Hall, A. F. (2009) *A Unique Agreement: A historical perceptive on creation and breakdown of the 'Gentleman's Agreement' for flood insurance in the UK.* The University of Manchester.

Hall, J.*, et al.* (2003) 'Integrated flood risk management in England and Wales', *Natural Hazards Review,* 4(3), pp. 126-135.
Hall, J. and Solomatine, D. (2008) 'A framework for uncertainty analysis in flood risk management decisions', *International Journal of River Basin Management,* 6(2), pp. 85-98.
Hall, S. (2011) 'The neo-liberal revolution', *Cultural studies,* 25(6), pp. 705-728.
Hamilton, R. A. (2015) *Governing through risk: synthetic biology and the risk management process.* The London School of Economics and Political Science (LSE).
Hammond, M. J.*, et al.* (2015) 'Urban flood impact assessment: A state-of-the-art review', *Urban Water Journal,* 12(1), pp. 14-29.
Harries, T. (2008) 'Feeling secure or being secure? Why it can seem better not to protect yourself against a natural hazard', *Health, risk & society,* 10(5), pp. 479-490.
Harris, L. M. and Alatout, S. (2010) 'Negotiating hydro-scales, forging states: Comparison of the upper Tigris/Euphrates and Jordan River basins', *Political Geography,* 29(3), pp. 148-156.
Haughton, G., Bankoff, G. and J Coulthard, T. (2015) 'In search of 'lost'knowledge and outsourced expertise in flood risk management', *Transactions of the Institute of British Geographers,* 40(3), pp. 375-386.
Healey, P. (2006) *Collaborative planning: Shaping places in fragmented societies.* UBc Press.
Hegger, D. L.*, et al.* (2014) 'Assessing stability and dynamics in flood risk governance', *Water Resources Management,* 28(12), pp. 4127-4142.
Heriard-Dubreuil, G. F. (2001) 'Present challenges to risk governance', *Journal of hazardous materials,* 86(1-3), pp. 245-248.
Hermanns, H. (2004) '5.3 Interviewing as an Activity', *In: U. Flick, E. von Kardorff and I. Steinke (eds.) A companion to qualitative research. London: Sage Publications.*, pp. 209-2013.
Heyl, B. S. (2001) 'Ethnographic interviewing', *Handbook of ethnography*, pp. 369-383.
HM and Government (2012) *The UK Climate Change Risk Assessment 2012 Evidence Report. January 2012*.
Huber, M. (2004) *Reforming the UK flood insurance regime. The breakdown of a gentlemen's agreement.* Centre for Analysis of Risk and Regulation, London School of Economics and Political Science.
Hurlbert, M. and Gupta, J. (2015) 'The split ladder of participation: a diagnostic, strategic, and evaluation tool to assess when participation is necessary', *Environmental Science & Policy,* 50, pp. 100-113.
Hussain, A. (2014) 'Plight of the flood victims trapped by rising cover', *The Sunday Times*, pp. Business, Money. Available at: http://www.thesundaytimes.co.uk/sto/business/money/Consumer/article1483751.ece.
Involve, U. 2005. People and Participation: How to Put Citizens at the Heart of Decision Making. Involve London.
Irwin, A. (2002) *Citizen science: A study of people, expertise and sustainable development.* Routledge.
ISDR, U. 'Hyogo framework for action 2005-2015: building the resilience of nations and communities to disasters'. *Extract from the final report of the World Conference on Disaster Reduction (A/CONF. 206/6)*.
Jacobs, J. 1992. Systems of Survival: A Dialogue on the Moral Foundations of Commerce and Politics. New York: Vintage.
Jain, A. K. and Jeppe Jeppesen, H. (2013) 'Knowledge management practices in a public sector organisation: the role of leaders' cognitive styles', *Journal of Knowledge Management,* 17(3), pp. 347-362.
Jasanoff, S. (2003) 'Breaking the waves in science studies: comment on HM Collins and Robert Evans,The third wave of science studies", *Social studies of science,* 33(3), pp. 389-400.
Jessop, B. 1999. The Governance of Complexity and the Complexity of Governance: Preliminary remarks on some problems and limits of economic guidance, Department of Sociology, Lancaster University, Lancaster LA1 4YN.
Jessop, B. (2007) *State power: A strategic-relational approach.* Polity.
Jha, A. K., Bloch, R. and Lamond, J. (2012) *Cities and Flooding: A Guide to Integrated Urban Flood Risk Management for the 21st Century.* Washington DC: The World Bank.
Jongman, B.*, et al.* (2012) 'Comparative flood damage model assessment: towards a European approach', *Nat. Hazards Earth System Science*. doi: doi:10.5194/nhess-12-3733-2012.
Jordan, A. (2008) 'The governance of sustainable development: taking stock and looking forwards', *Environment and planning C: Government and policy,* 26(1), pp. 17-33.
Jordan, A.*, et al.* (2003) 'Policy innovation or'muddling through'?'New'environmental policy instruments in the United Kingdom', *Environmental Politics,* 12(1), pp. 179-200.
Joseph, R., Proverbs, D. and Lamond, J. (2015) 'Homeowners' perception of the benefits of property level flood risk adaptation (PLFRA) measures: The case of the summer 2007 event in England', *International Journal of Safety and Security Engineering,* 5(3), pp. 251-265.
Joseph, R.*, et al.* (2011) 'An analysis of the costs of resilient reinstatement of flood affected properties: a case study of the 2009 flood event in Cockermouth', *Structural Survey,* 29(4), pp. 279-293.

Joseph, R. D. (2014) *Development of a comprehensive systematic qualification of the cost and benefits (CD) of property level flood risk adaptation measures on England.* PhD thesis. University of the West of England.
Kaiser, R. and Nikiforova, E. (2008) 'The performativity of scale: the social construction of scale effects in Narva, Estonia', *Environment and Planning D: Society and Space,* 26(3), pp. 537-562.
Kar-Purkayastha, I., Clarke, M. and Murray, V. (2011) 'Dealing with disaster databases–what can we learn from health and systematic reviews?: Application in practice', *PLoS currents,* 3.
Kelman, I. (2002) *Physical Flood Vulnerability of Residential Properties in Coastal, Eastern England* University of Cambridge.
Kelman, I. (2005) 'Floods should not mean disasters', *Building Research & Information,* 33(3), pp. 287-292.
Kelman, I. and Spence, R. (2004) 'An overview of flood actions on buildings', *Engineering Geology,* 73(3-4), pp. 297-309.
Kenney, S.*, et al.* (2006) 'Flood risk and property: Impacts on commercial & residential stakeholders' strategies'. Reading, England.
King, C. S., Feltey, K. M. and Susel, B. O. N. (1998) 'The question of participation: Toward authentic public participation in public administration', *Public administration review*, pp. 317-326.
Klijn, F.*, et al.* (2015) 'Adaptive flood risk management planning based on a comprehensive flood risk conceptualisation', *Mitigation and Adaptation Strategies for Global Change,* 20(6), pp. 845-864.
knowyourfloodrisk.co.uk (2015) 'Sample flood report'. Available at: http://www.knowyourfloodrisk.co.uk/sites/all/themes/kyfr/pdf/KYFR_Sample_Report.pdf (Accessed: 17 May 2016).
Krahmann, E. (2003) 'National, regional, and global governance: one phenomenon or many', *Global governance,* 9, pp. 323.
Kreibich, H.*, et al.* (2017) 'HOWAS21, the German Flood Damage Database', *Flood Damage Survey and Assessment: New Insights from Research and Practice,* 228, pp. 65.
Kreibich, H. and Thieken, A. H. (2008) 'Assessment of damage caused by high groundwater inundation', *Water Resources Research,* 44(9).
Krieger, K. and Demeritt, D. (2015) *Limits of insurance as risk governance: M arket failures and disaster politics in German and British private flood insurance* DISCUSSION PAPER NO: 80: Centre for Analysis of Risk and Regulation at the London School of Economics and Political ScienceAvailable at: http://www.lse.ac.uk/accounting/CARR/pdf/DPs/DP-Krieger-Demeritt.pdf.
Kron, W.*, et al.* (2012) *How to deal properly with a natural catastrophe database – analysis of flood losses*. Geo Risks Research, Munich Re, MunichAvailable at: http://nat-hazards-earth-syst-sci.net/12/535/2012/nhess-12-535-2012.pdf (Accessed: 28 April).
Kuhlicke, C.*, et al.* (2011) 'Perspectives on social capacity building for natural hazards: outlining an emerging field of research and practice in Europe', *Environmental science & policy,* 14(7), pp. 804-814.
Kundzewicz, Z. W. and Takeuchi, K. (1999) 'Flood protection and management: quo vadimus?', *Hydrological Sciences Journal,* 44(3), pp. 417-432.
Kunreuther, H. and Pauly, M. (2006) 'Insurance decision-making and market behavior', *Foundations and Trends® in Microeconomics,* 1(2), pp. 63-127.
Laffin, M. (2013) 'A new politics of governance or an old politics of central–local relations? Labour's reform of social housing tenancies in England', *Public Administration,* 91(1), pp. 195-210.
Lafinhan, D. (2016) *The changing governance of UK flood management policies 1998-2010: a comparative analysis of local approaches in Scotland and England.* University of Nottingham.
Lamond, J. and Penning-Rowsell, E. (2014) 'The robustness of flood insurance regimes given changing risk resulting from climate change', *Climate Risk Management,* 2, pp. 1-10.
Lamond, J., Proverbs, D. and Hammond, F. (2010) 'The impact of flooding on the price of residential property: a transactional analysis of the UK market', *Housing studies,* 25(3), pp. 335-356.
Lamond, J.*, et al.* (2018) 'Evidence review for property flood resilience phase 2 report'.
Lamond, J. E., Proverbs, D. and Hammond, F. (2009) 'Accessibility of flood risk insurance in the UK: confusion, competition and complacency', *Journal of Risk Research,* 12(6), pp. 825-841.
Lane, S. N.*, et al.* (2011) 'Doing flood risk science differently: an experiment in radical scientific method', *Transactions of the Institute of British Geographers,* 36(1), pp. 15-36.
Lange, P.*, et al.* (2013) 'Governing towards sustainability—conceptualizing modes of governance', *Journal of environmental policy & planning,* 15(3), pp. 403-425.
Lemke, T. (2002) 'Foucault, Governmentality and Critique', *Political Studies Review,* 12(2), pp. 260-261.
Lidskog, R., Uggla, Y. and Soneryd, L. (2011) 'Making transboundary risks governable: Reducing complexity, constructing spatial identity, and ascribing capabilities', *Ambio,* 40(2), pp. 111-120.

Lin, T., De Guzman, F. D. and Cuevas, M. C. (2007) 'Flood insurance as a flood management tool: An economic perspective'.
Lincoln, Y. S. (2004) 'Norman K. Denzin: life in transit', *A companion to qualitative research*, pp. 53-57.
Linford, T. (2016) *Key flood data goes open- Defra digital*Available at: https://defradigital.blog.gov.uk/2016/03/31/historical-flood-data-goes-open/ (Accessed: 12 March 2018).
Lowndes, V. and Sullivan, H. (2004) 'Like a horse and carriage or a fish on a bicycle: how well do local partnerships and public participation go together?', *Local government studies,* 30(1), pp. 51-73.
Lukes, S. (2012) 'Power: A Radical View [2005]', *Contemporary Sociological Theory,* 266.
Lummen, N. S.*, et al.* (2016) 'Flood risk management an illustrative approach', *International Journal of Disaster Resilience in the Built Environment,* 7(4), pp. 388-405.
Luyet, V. (2005) *A Framework for the Participative Process in a Large Environmental Project. Case study: the 3rd Rhone river correction.* PhD thesis.
Mackenzie, N. and Knipe, S. (2006) 'Research dilemmas: Paradigms, methods and methodology', *Issues In Educational Research,* 16, pp. 193-205.
Markus, M. L., Steinfield, C. W. and Wigand, R. T. (2006) 'Industry-wide information systems standardization as collective action: the case of the US residential mortgage industry', *MIS quarterly*, pp. 439-465.
Marston, S. A., Jones III, J. P. and Woodward, K. (2005) 'Human geography without scale', *Transactions of the Institute of British Geographers,* 30(4), pp. 416-432.
Mason, M. 'Sample size and saturation in PhD studies using qualitative interviews'. *Forum qualitative Sozialforschung/Forum: qualitative social research*.
Matczak, P.*, et al.* (2016) 'Comparing flood risk governance in six European countries: strategies, arrangements and institutional dynamics'.
Mayntz, R. (2003) 'New challenges to governance theory', *Governance as social and political communication,* 27, pp. 40.
Mayo, M. and Taylor, M. (2001) 'Partnerships and power in community regeneration', *Partnership working: Policy and practice*, pp. 39-56.
McNeill, D. (1999) 'On interdisciplinary research: With particular reference to the field of environment and development', *Higher Education Quarterly,* 53(4), pp. 312-332.
Mees, H. L., Driessen, P. P. and Runhaar, H. A. (2014) 'Legitimate adaptive flood risk governance beyond the dikes: the cases of Hamburg, Helsinki and Rotterdam', *Regional Environmental Change,* 14(2), pp. 671-682.
Merkens, H. (2004) '4.4 Selection Procedures, Sampling, Case Construction', *A companion to qualitative research*.
Merz, B.*, et al.* (2010a) 'Fluvial flood risk management in a changing world', *Natural Hazards and Earth System Sciences,* 10(3), pp. 509.
Merz, B., Kreibich, H. and Lall, U. (2013) 'Multi-variate flood damage assessment: a tree-based data-mining approach', *Natural Hazards and Earth System Sciences,* 13(1), pp. 53.
Merz, B.*, et al.* (2010b) *Review article "Assessment of economic flood damage"*Available at: http://www.nat-hazards-earth-syst-sci.net/10/1697/2010/nhess-10-1697-2010.pdf (Accessed: 13 May 2015).
Merz, B.*, et al.* (2004) 'Estimation uncertainty of direct monetary flood damage to buildings', *Natural Hazards and Earth System Science,* 4(1), pp. 153-163.
Messner, F. and Meyer, V. (2006) 'Flood damage, vulnerability and risk perception–challenges for flood damage research', *Flood risk management: hazards, vulnerability and mitigation measures*: Springer, pp. 149-167.
Messner, F.*, et al.* (2007) 'Evaluating flood damages: guidance and recommendations on principles and methods ' T09-06-01). Available at: http://www.floodsite.net/html/partner_area/project_docs/T09_06_01_Flood_damage_guidelines_D9_1_v2_2_p44.pdf.
Meuser, M. and Nagel, U. (2009) 'The expert interview and changes in knowledge production', *Interviewing experts*: Springer, pp. 17-42.
Meyer, V. and Messner, F. (2005) 'National flood damage evaluation methods: a review of applied methods in England, the Netherlands, the Czech Republik and Germany': UFZ-Diskussionspapiere.
Milly, P. C. D.*, et al.* (2002) 'Increasing risk of great foods in a changing climate', *Nature,* 415.
Mitchell, R. K., Agle, B. R. and Wood, D. J. (1997) 'Toward a theory of stakeholder identification and salience: Defining the principle of who and what really counts', *Academy of management review,* 22(4), pp. 853-886.
Mohr, J. J. and Sengupta, S. (2002) 'Managing the paradox of inter-firm learning: the role of governance mechanisms', *Journal of Business & Industrial Marketing,* 17(4), pp. 282-301.

Mojtahedi, M. S. and Oo, B. L. 'Stakeholders' approaches towards natural disasters in built environment: a theoretical framework'. *Proceedings of the 28th Annual ARCOM Conference (Smith SD (ed.))*, 3-5.
Molinari, D., Menoni, S. and Ballio, F. (2017) *Flood Damage Survey and Assessment: New Insights from Research and Practice.* John Wiley & Sons.
Morse, J. M. 2000. Determining sample size. Sage Publications Sage CA: Thousand Oaks, CA.
Moss, T. and Newig, J. 2010. Multilevel water governance and problems of scale: Setting the stage for a broader debate. Springer.
Mostert, E. (2003) 'The challenge of public participation', *Water policy,* 5(2), pp. 179-197.
Mostert, E. and Junier, S. J. (2009) 'The European flood risk directive: challenges for research', *Hydrology and Earth System Sciences Discussions*, pp. 4961–4988.
nationalfloodforum.org.uk (2016) *Property Level Advisor*Available at: http://www.nationalfloodforum.org.uk/flood-protection-adviser/ (Accessed: 16 November 2016).
Neal, S. (2013) 'Transition culture: Politics, localities and ruralities', *Journal of Rural Studies,* 32, pp. 60-69.
Newig, J. and Kvarda, E. (2012) 'Participation in environmental governance: legitimate and effective', *Environmental Governance: The Challenge of Legitimacy and Effectiveness; Hogl, K., Kvarda, E., Nordbeck, R., Pregernig, M., Eds*, pp. 29-45.
NFF (2014) *Consultation on the implementing regulations for the Flood Reinsurance Scheme – National Flood Forum response*Available at: http://www.nationalfloodforum.org.uk/wp-content/uploads/140916-NFF-Flood-Re-Consultation-response.pdf (Accessed: 9 December).
Nicholas, J., Holt, G. D. and Proverbs, D. G. (2001) 'Towards standardising the assessment of flood damaged properties in the UK', *Structural Survey,* 19.
Nooteboom, B.*, et al.* (2007) 'Optimal cognitive distance and absorptive capacity', *Research policy,* 36(7), pp. 1016-1034.
Norman, E. S., Bakker, K. and Cook, C. (2012) 'Introduction to the Themed Section: Water Governance and the Politics of Scale', *Water Alternatives,* 5(1).
Notaro, V.*, et al.* (2013) 'The effect of damage functions on urban flood damage appraisal', *12th International Conference on Computing and Control for the Water Industry*. Italy, pp. 1251-1260.
Note by the European Union 2010. Information exchanges between competitors under EU competition law.
Nye, J. S. and Donahue, J. D. (2000) *Governance in a globalizing world.* Brookings Institution Press.
O'Malley, P. (2010) 'Resilient subjects: Uncertainty, warfare and liberalism', *Economy and Society,* 39(4), pp. 488-509.
O'Riordan, T. (2004) 'Environmental science, sustainability and politics', *Transactions of the Institute of British Geographers,* 29(2), pp. 234-247.
O'Sullivan, J.*, et al.* (2012) 'Enhancing flood resilience through improved risk communications', *Natural Hazards and Earth System Sciences,* 12(7), pp. 2271-2282.
Oakley, M. (2018) *Incentivising household action on flooding: Options for using incentives to increase the take*

up of flood resilience and resistance measures. London: The Social Market Foundation.
ODPM, Minister, O.o.t.D.P. (2003) *Preparing for floods: Interim guidance for improving the flood resistance ofdomestic and small business properties.* London: Office of the Deputy Prime Minister.
ordinancesurvey.co.uk (2017) *About Resilience Direct*Available at: https://www.ordnancesurvey.co.uk/business-and-government/public-sector/resilience-direct/about.html (Accessed: 14 March 2017).
Owens, S. (2005) 'Making a difference? Some perspectives on environmental research and policy', *Transactions of the institute of British Geographers,* 30(3), pp. 287-292.
Pahl-Wostl, C.*, et al.* (2013) 'How multilevel societal learning processes facilitate transformative change: a comparative case study analysis on flood management', *Ecology and Society,* 18(4).
Pahl-Wostl, C.*, et al.* (2007) 'Social learning and water resources management', *Ecology and society,* 12(2).
Pahl-Wostl, C. and Hare, M. (2004) 'Processes of social learning in integrated resources management', *Journal of Community & Applied Social Psychology,* 14(3), pp. 193-206.
Parker, D. (1987) 'The Institutional and Policy Context', in Hadmer, J. (ed.) *Flood Hazard Management: British and International Perspectives*. Norwich: Geobooks.
Parker, D. J. (2000) *Floods.* Taylor & Francis.
Parliament (2010) *Flood and Water Management Act.* UK.
Peck, J. and Tickell, A. (2002) 'Neoliberalizing space', *Antipode,* 34(3), pp. 380-404.
Pemsel, S.*, et al.* (2014) 'A conceptualization of knowledge governance in project-based organizations', *International Journal of Project Management,* 32(8), pp. 1411-1422.

Penning-Rowsell, E., Johnson, C. and Tunstall, S. (2006) ''Signals' from pre-crisis discourse: lessons from UK flooding for global environmental policy change?', *Global Environmental Change,* 16(4), pp. 323-339.
Penning-Rowsell, E.*, et al.* (2005) *The Benefits of Flood and Coastal Risk Management: A Handbook of Assessment Techniques* London: Middlesex University Press.
Penning-Rowsell, E.*, et al.* (2013) *Flood and Coastal Erosion Risk Management: A Manual for Economic Appraisal.* Routledge.
Penning-Rowsell, E., Priesta, S. and Johnson, C. (2014) 'The evolution of UK flood insurance: incremental change over six decades', *International Journal of Water Resources Development* 30, pp. 694–713.
Penning-Rowsell, E. C.*, et al.* (2014) 'Innovation in coastal risk management: An exploratory analysis of risk governance issues at eight THESEUS study sites', *Coastal Engineering,* 87, pp. 210-217.
Penning-Rowsell, E. C. and Johnson, C. (2015) 'The ebb and flow of power: British flood risk management and the politics of scale', *Geoforum,* 62, pp. 131-142.
Pestre, D. (2003) 'Regimes of knowledge production in society: Towards a more political and social reading', *Minerva,* 41(3), pp. 245-261.
Pfadenhauer, M. (2009) 'At eye level: The expert interview—a talk between expert and quasi-expert', *Interviewing experts*: Springer, pp. 81-97.
Pidgeon, N. F.*, et al.* (2005) 'Using surveys in public participation processes for risk decision making: The case of the 2003 British GM nation? Public debate', *Risk Analysis: An International Journal,* 25(2), pp. 467-479.
Pimlott, D., Giles, C. and Harding, R. (2010) 'UK unveils dramatic austerity measures', *Financ. Times,* 20(October), pp. 2010.
Pitt, M., Office, C. (2008) *The Pitt Review - Learning Lessons from the 2007 floods.* 22 Whitehall, London SW1A 2WH.
Ponterotto, J. G. (2005) 'Qualitative research in counseling psychology: A primer on research paradigms and philosophy of science', *Journal of counseling psychology,* 52(2), pp. 126.
populationmatters.org (2016) *Population growth exacerbates flood risk*Available at: http://www.populationmatters.org/documents/population_growth_exacerbates_flood_risk.pdf (Accessed: 10 February 2016).
Porter, J. and Demeritt, D. (2012) 'Flood-risk management, mapping, and planning: the institutional politics of decision support in England', *Environment and Planning A,* 44(10), pp. 2359-2378.
Priestley, S., research, T.H.o.C.L. (2017) *Flood risk management and funding, Briefing Paper Number CBP07514*.
Pugalis, L. and Townsend, A. (2013) 'Rescaling of planning and its interface with economic development', *Planning Practice & Research,* 28(1), pp. 104-121.
Ratner, C. (2008) 'Cultural psychology and qualitative methodology: Scientific and political considerations', *Culture & Psychology,* 14(3), pp. 259-288.
Reed, M. S. (2008) 'Stakeholder participation for environmental management: a literature review', *Biological conservation,* 141(10), pp. 2417-2431.
Reed, M. S.*, et al.* (2009) 'Who's in and why? A typology of stakeholder analysis methods for natural resource management', *Journal of environmental management,* 90(5), pp. 1933-1949.
Reese, S. (2003) *Die Vulnerabilität des schleswig-holsteinischen Küstenraumes durch Sturmfluten: Fallstudien von der Nord-und Ostseeküste.* Forschungs-u. Technologiezentrum Westküste.
Regional Development Agencies Act (1998) *London: HMSO*Available at: https://www.legislation.gov.uk/ukpga/1998/45/pdfs/ukpga_19980045_en.pdf.
Renn, O. 'Risk governance: towards an integrative framework'. *International Disaster Reduction Conference, Davos, Switzerland*.
Renn, O. (2017) *Risk governance: coping with uncertainty in a complex world.* Routledge.
Renn, O., Klinke, A. and Van Asselt, M. (2011) 'Coping with complexity, uncertainty and ambiguity in risk governance: a synthesis', *Ambio,* 40(2), pp. 231-246.
Rhodes, R. A. (1997) *Understanding governance: Policy networks, governance, reflexivity and accountability.* Open university press.
Rip, A. (2003) 'Constructing expertise: In a third wave of science studies?', *Social studies of science,* 33(3), pp. 419-434.
Rose, N. (1996) 'Governing "advanced" liberal democracies', *The anthropology of the state: A reader,* 144162.
Sanders, C. and Phillipson, M. (2003) 'UK adaptation strategy and technical measures: the impacts of climate change on buildings', *Building Research & Information,* 31(3-4), pp. 210-221.
Sayers, P., Hall, J. and Meadowcroft, I. 'Towards risk-based flood hazard management in the UK'. *Proceedings of the Institution of Civil Engineers-Civil Engineering*: Thomas Telford Ltd, 36-42.

Sayers, P.*, et al.* (2013) *Flood risk management: A strategic approach.* Paris: UNESCO.
Sayers, P. B.*, et al.*, Change, R.u.b.S.a.P.o.b.o.t.C.o.C. (2015) *Climate Change Risk Assessment 2017: Projections of future flood risk in the UK.* London: Published by Committee on Climate Change.
Schwarz, J. and Maiwald, H. 'Damage and loss prediction model based on tion model based on the vulnerability of building types'. *4th International Symposium on Flood Defence*. Toronto, Canada.
Scottish Environment Protection Agency 2012. Land Use Planning System SEPA Guidance Note 23. *Strategic Flood Risk Assessment - SEPA technical guidance to support Development Planning.*
Scrase, J. I. and Sheate, W. R. (2005) 'Re-framing flood control in England and Wales', *Environmental Values,* 14(1), pp. 113-137.
Serje, J. (2017) 'Overview of the United Nations Global Loss Data Collection Initiative', *Flood Damage Survey and Assessment: New Insights from Research and Practice*, pp. 1-16.
Sidorov, D. (2000) 'National monumentalization and the politics of scale: the resurrections of the Cathedral of Christ the Savior in Moscow', *Annals of the Association of American Geographers,* 90(3), pp. 548-572.
Sikor, T. (2013) *Public and private in natural resource governance: a false dichotomy?*: Routledge.
Simon, M. (1990) 'Strategic Function Typology', *The Hague*.
Skelcher, C. (2000) 'Changing images of the state: overloaded, hollowed-out, congested', *Public policy and administration,* 15(3), pp. 3-19.
Skelcher, C., Mathur, N. and Smith, M. (2005) 'The public governance of collaborative spaces: Discourse, design and democracy', *Public administration,* 83(3), pp. 573-596.
Small, G., Newby, L. and Clarkson, I. 'Opinion versus Reality: Flood-affected property values in Rockhampton, Australia'. *Proceedings of the Pacific Rim Real Estate Society international conference*.
Smith, D. M. and Wistrich, E. (2016) *Devolution and localism in England.* Routledge.
Smith, K. and Tobin, G. A. (1979) 'Human adjustment to the flood hazard'.
Smith, K. and Ward, R. (1998) 'Floods-Physical Processes and Human Impacts', *John Wiley & Sons*.
Soetanto, R. and Proverbs, D. G. (2004) 'Impact of flood characteristics on damage caused to UK domestic properties: the perceptions of building surveyors', *Structural Survey,* 22(2), pp. 95-104.
Speyrer, J. F. and Ragas, W. R. (1991) 'Housing prices and flood risk: an examination using spline regression', *The Journal of Real Estate Finance and Economics,* 4(4), pp. 395-407.
Stanghellini, P. L. and Collentine, D. (2008) 'Stakeholder discourse and water management? implementation of the participatory model CATCH in a Northern Italian alpine sub-catchment', *Hydrology and Earth System Sciences Discussions,* 12(1), pp. 317-331.
Stanghellini, P. S. L. (2010) 'Stakeholder involvement in water management: the role of the stakeholder analysis within participatory processes', *Water Policy,* 12(5), pp. 675-694.
Steinführer, A.*, et al.* (2008) 'Towards flood risk management with the people at risk: From scientific analysis to practice recommendations (and back)', *Flood Risk Management: Research and Practice: Extended Abstracts,* 332, pp. 167.
Sterna, L. (2012) 'Pluvial flood damage modelling: Assessment of the flood damage model HOWAD-PREVENT'.
Steurer, R., Bauer, A. and Feichtinger, J. (2010) 'The governance of adaptation to climate change: taking stock and providing guidance', *Analytical framework for the stock taking survey of governance approaches in,* 10.
Stevens, A. J., Clarke, D. and Nicholls, R. J. (2016) 'Trends in reported flooding in the UK: 1884–2013', *Hydrological Sciences Journal,* 61(1), pp. 50-63.
Stoker, G. (2011) 'Was local governance such a good idea? A global comparative perspective', *Public administration,* 89(1), pp. 15-31.
Stott, P. A. and Sullivan, S. (2000) 'Political ecology: science, myth and power'.
Strauss, A. and Corbin, M. J. (2007) 'Basics of qualitative research: Techniques and procedures for developing grounded theory', *Thousand Oaks, CA: Sage*.
Stren, R. E. (2000) 'New approaches to urban governance in Latin America'.
Sultana, P., Thompson, P. and Green, C. (2008) 'Can England learn lessons from Bangladesh in introducing participatory floodplain management?', *Water resources management,* 22(3), pp. 357-376.
Surminski , S. (2016) *Flood Re: a missed opportunity for sustainable flood risk management?*Available at: http://www.lse.ac.uk/GranthamInstitute/news/flood-re-a-missed-opportunity-for-sustainable-flood-risk-management/ (Accessed: 19 December 2017).
Surminski, S. and Eldridge, J. (2014) 'Flood insurance in England- An assessment of the current and newly proposed insurance scheme in the context of rising flood risk', *Journal of Flood Risk Management*.

Surminski, S. and Oramas-Dorta, D. (2013) 'Do flood insurance schemes in developing countries provide incentives to reduce physical risks', *Grantham Research Institute on Climate Change and the Environment Working Papers,* 119.
Surminski, S. and Oramas-Dorta , D. (2013) 'Do flood insurance schemes in developing countries provide incentives to reduce physical risks?', *Grantham Research Institute on Climate Change and the Environment Working Papers,119.*
swim.geowessex.com (no date) *Record property flooding*Available at: https://swim.geowessex.com/dorset/Help/about (Accessed: 13 February 2016).
Swyngedouw, E. (2002) 'Scaled Geographies: Nature, Place, and the Politics of Scale, disponible sur: http://www. researchgate. net/profile', *Erik_Swyngedouw/publication/255609407_Nature_Place _and_the_Politics_of_Scale/links/02e7e53b17da2394c9000000. pdf, 36p*.
Swyngedouw, E. (2004) 'Globalisation or 'glocalisation'? Networks, territories and rescaling', *Cambridge review of international affairs,* 17(1), pp. 25-48.
Syal, R. (2016) 'Green deal scheme did not deliver energy savings, audit finds', *The Guardian*. Available at: https://www.theguardian.com/environment/2016/apr/14/green-deal-scheme-did-not-deliver-energy-savings-audit-finds.
Szerszynski, B. (1999) 'Risk and trust: The performative dimension', *Environmental Values,* 8(2), pp. 239-252.
Tapsell, S. M.*, et al.* (2002) 'Vulnerability to Flooding: Health and Social Dimensions', *Flood Risk in a Changing Climate* 360.
Tapsell, S. M. and Tunstall, S. M. (2008) '"I wish I'd never heard of Banbury": The relationship between 'place'and the health impacts from flooding', *Health & place,* 14(2), pp. 133-154.
Tashakkori, A. and Teddlie, C. (2010) *Sage handbook of mixed methods in social & behavioral research.* Sage.
Termeer, C., Dewulf, A. and Breeman, G. (2013) 'Governance of wicked climate adaptation problems', *Climate change governance*: Springer, pp. 27-39.
Thaler, T. and Levin-Keitel, M. (2016) 'Multi-level stakeholder engagement in flood risk management—A question of roles and power: Lessons from England', *Environmental Science & Policy,* 55, pp. 292-301.
Thaler, T. and Priest, S. (2014) 'Partnership funding in flood risk management: new localism debate and policy in England', *Area,* 46(4), pp. 418-425.
Thieken, A. H.*, et al.* (2014) 'Preface: Flood resilient communities–managing the consequences of flooding', *Natural Hazards and Earth System Sciences,* 14(1), pp. 33-33.
Thieken, A. H.*, et al.* (2005) 'Flood damage and influencing factors: New insights from the August 2002 flood in Germany', *Water resources research,* Volume 41(Issue 12). doi: 10.1029/2005WR004177.
Thiel, A. (2010) 'Constructing a strategic, national resource: European policies and the up-scaling of water services in the Algarve, Portugal', *Environmental management,* 46(1), pp. 44-59.
Titi Amayah, A. (2013) 'Determinants of knowledge sharing in a public sector organization', *Journal of knowledge management,* 17(3), pp. 454-471.
Tschoegl, L., Below, R. and Guha-Sapir, D. (2006) *An analytical review of selected data sets on natural disasters and impacts.* Centre for Research on the Epidemiology of Disasters Louvain.
Tseng, C. P. and Penning-Rowsell, E. C. (2012) 'Micro-political and related barriers to stakeholder engagement in flood risk management', *The Geographical Journal,* 178(3), pp. 253-269.
Tunstall, S., Johnson, C. and Penning-Rowsell, E. 'Flood hazard management in England and Wales: from land drainage to flood risk management'. *World Congress on Natural Disaster Mitigation*, 19-21.
UNDP (2013) 'A comparative review of country-level and regional disaster loss and damage databases'. New York: Bureau for Crisis Prevention and Recovery United Nations Development Programme. Available at: http://www.undp.org/content/dam/undp/library/crisis%20prevention/disaster/asia_pacific/lossanddamagedatabase.pdf.
UNISDR, UNISDR (2015) *Sendai framework for disaster risk reduction 2015–2030.* Geneva.
United Nations (2012) *Current knowledge on relevant methodologies and data requirements as well as lessons learned and gaps identified at different levels, in assessing the risk of loss and damage associated with the adverse effects of climate change.*
Van Bueren, E. M., Klijn, E. H. and Koppenjan, J. F. (2003) 'Dealing with wicked problems in networks: Analyzing an environmental debate from a network perspective', *Journal of public administration research and theory,* 13(2), pp. 193-212.
Vedwan, N.*, et al.* (2008) 'Institutional evolution in Lake Okeechobee management in Florida: characteristics, impacts, and limitations', *Water Resources Management,* 22(6), pp. 699-718.

Walker, G., Tweed, F. and Whittle, R. (2014) 'A framework for profiling the characteristics of risk governance in natural hazard contexts', *Natural Hazards and Earth System Sciences,* 14(1), pp. 155-164.
Water Act (1989) *London: HMSO*Available at: https://www.legislation.gov.uk/ukpga/1989/15/contents.
Watson, N.*, et al.* (2009) 'Institutional and social responses to flooding from a resilience perspective'.
Whatmore, S. J. (2009) 'Mapping knowledge controversies: science, democracy and the redistribution of expertise', *Progress in Human Geography,* 33(5), pp. 587-598.
White, I., Kingston, R. and Barker, A. (2010) 'Participatory geographic information systems and public engagement within flood risk management', *Journal of Flood Risk Management,* 3(4), pp. 337-346.
Wiek, A. and Larson, K. L. (2012) 'Water, people, and sustainability—a systems framework for analyzing and assessing water governance regimes', *Water Resources Management,* 26(11), pp. 3153-3171.
Wiering, M.*, et al.* (2015) 'The rationales of resilience in English and Dutch flood risk policies', *Journal of Water and Climate Change,* 6(1), pp. 38-54.
Wiering, M. and Immink, I. (2006) 'When water management meets spatial planning: a policy-arrangements perspective', *Environment and planning C: Government and policy,* 24(3), pp. 423-438.
Wiering, M.*, et al.* (2017) 'Varieties of flood risk governance in Europe: How do countries respond to driving forces and what explains institutional change?', *Global environmental change,* 44, pp. 15-26.
Wissen, M. (2009) 'Contested terrains: Politics of scale, the national state and struggles for the control over nature', *Review of International Political Economy,* 16(5), pp. 883-906.
Yang, S.-M.*, et al.* (2014) 'Knowledge exchange and knowledge protection in interorganizational learning: The ambidexterity perspective', *Industrial Marketing Management,* 43(2), pp. 346-358.
Young, O. R. (2005) 'Why is there no unified theory of environmental governance?', *Handbook of global environmental politics*, pp. 170.
Zevenbergen, C.*, et al.* (2008) 'Challenges in urban flood management: travelling across spatial and temporal scales', *Journal of Flood Risk Management,* 1(2), pp. 81-88.

Appendix A

PhD Research Information Sheet (Interview protocols)

You are being invited to take part in a research study. Before you decide whether or not to take part, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully.

Title of the study: Collaborative flood risk governance at the scale of property level: an exploration of challenges in the use and availability of flood risk data in England

Principal researchers:

Prof Ray Ogden (rgogden@brookes.ac.uk)
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What is the purpose of the study?

This research is focused on evaluating the advantage of property level flood data, in comparison to more generalised form of flood data in relation to the current needs of key stakeholder groups (including government, insurers and home owners). This would help to identify factors promoting or prejudicing the adaptation of property level approach in different aspects of flood risk management. The study also explores measures that facilitate the use of property level flood risk data following the relevant recommendations by the government (i.e. Defra 2010*: 'Availability and uses of property level flood risk data and information FD2637/TR'* and, Defra 2011: '*Flood risk and insurance: A road map to 2013 and beyond'* and EA 2011*: FCRM: Risk mapping strategy 2010-2015').*

The field study is expected to run until February 2017. Data will be collected and analysed from interviews with the key stakeholders including Government, insures and property owners and community representative groups. Final results will be a PhD thesis and a summary report for participants. There is also the possibility that the finding will be published in a relevant journal.

Why have I been invited to participate?

You have been invited to participate because of your knowledge of one of the aspects of this research. You might be:

1. A member of the government organisation with the responsibility to manage flood.

2. A professional member of the insurance industry with experience in insuring properties at risk of flooding in England.

3. A member of community representative who supports individuals at risk of flooding.

Do I have to take part?

It is up to you to decide whether or not to take part. If you do decide to take part you will be given this information sheet to keep and be asked to sign a consent form. If you decide to take part you are still free to withdraw at any time and without giving a reason.

What will happen to me if I take part?

You will be asked to take part in an interview, either in person, or on the phone. The nature of the information is not anticipated to be of a sensitive nature. You will be asked about your experiences, perceptions and opinion related to the use and availability of property level flood data in meeting with your specific requirements. The interview will last approximately 45 minutes. If you give your consent, an audio of the interview will be recorded. Otherwise, authorised notes will be taken.

I hope that the interview will give you an opportunity to reflect the advantages/disadvantages and opportunity/limits of property level flood data in England which will eventually be important to improve the risk based flood risk management in the country.

What are the possible disadvantages and risks of taking part?

There are no potential risks for participants taking part in interviews.

Will what I say in this study be kept confidential?

All information collected about will be kept strictly confidential but anonymity cannot be completely guaranteed (as it is subject to legal limitations). Confidentiality, privacy and anonymity will be ensured in the collection, storage and publication of research material. Data generated by the study will be retained in accordance with the University's policy on Academic Integrity and kept securely in electronic form for a period of ten years after the completion of this research project.

What should I do if I want to take part?

If you would like to take part in this study after this period, please send a reply to 14089450@brookes.ac.uk

What will happen to the results of the research study?

The research will be submitted to Oxford Brookes University, and graded as part of a requirement for completion of a Doctor of Philosophy (PhD) degree. Anonymity of participants will be ensured in the publication of research material in any form but as the sample size is small some implications for privacy/anonymity might occur. The data generated in the course of the research will be retained in accordance with the University's policy of Academic Integrity and must be kept securely in paper or electronic form for a period of ten years after the completion of a research project. Participants should be aware that there are legal limitations on data confidentiality and anonymity.

Who is organising and funding the research?

The research is being organised and undertaken by Shahrzad Amouzad a PhD research student in the school of Architecture under supervision of Prof. Ray Ogden, Dr Nicholas Walliman and Dr Bousmaha Baiche in the Faculty of Technology, Design and Environment, Oxford Brookes University, UK. It is funded by this University.

Who has reviewed the study?

This research has been approved by the University Research Ethics Committee, Oxford Brookes University. If you have any concerns about the way in which the study has been conducted, you should contact the Chair of the University Research Ethics Committee on ethics@brookes.ac.uk.

Contact for Further Information

For further information you can contact Shahrzad Amouzad at 14089450@brookes.ac.uk

Thank you for taking time to read the information sheet.

Shahrzad Amouzad

2016

Appendix B

Consent form

An Evaluation of the Risk Management Benefits of Property Level Flood Related Data

The research will be submitted to Oxford Brookes University, and graded as part of a requirement for completion of a Doctor of Philosophy (PhD) degree.

Principal researchers:

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Oxford Brookes University

Please initial box

1. I confirm that I have read and understand the information sheet for the above study and have had the opportunity to ask questions. ☐

2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving reason. ☐

3. *I agree to take part in the above study.* ☐

	Yes	No
4. *I agree to the interview being audio recorded*	☐	☐
5. *I agree to the use of anonymised quotes in publications*	☐	☐
6. *I agree that my data gathered in this study may be stored (after it has been anonymised) in a specialist data centre and may be used for future research.*	☐	☐

Name of Participant	Date	Signature
Name of Researcher	Date	Sign

Appendix C

Appendix C-1: Availability and use of Property Level Flood Risk Information - Future action plan

DEFRA, 2010, p.63 to69.

Improving the collection and management of property level flood risk information					
No	**Proposed action**	**Organisations involved**	**What will be the long term benefit?**	**What are the main barriers?**	**What is the future action needed?**
1A	Finalisation and active use of a consistent survey method/template for the survey/loss adjuster and insurance industry. This template should be designed to capture more consistent property level flood risk assessment and post event survey information. It is expected that a preliminary template will be finalised in spring/summer 2010 following work by the ABI, individual insurance companies and the Environment Agency on this issue.	Active promotion of the template by the ABI and individual insurance companies. Active implementation by the loss adjuster and survey industry.	This action would help to provide greater consistency within the industry and help promote the potential future sharing of non-sensitive data to professional partners such as the Environment Agency.	Difficulty of getting all relevant parties (including surveyors, loss adjusters and local authorities) to adopt and implement the template. Potential cost of changing business process and IT systems of organisations.	Encouragement for the insurance industry to adopt a standard format for the future collection of information relating to household and commercial claims. It is noted that issues of data capture and sharing are currently being discussed by a working group of insurance company representatives, the ABI and the Environment Agency. It is anticipated that this will ultimately lead to future improvements in capture and sharing of property related flood risk information.
1B	Continued development of nationally available maps of flood risk from other sources (i.e. surface water, groundwater and reservoir inundation maps) which can be shared directly with professional parties.	Environment Agency	Assist the development of future national flood risk appraisals and assist professional partners to identify locations of greatest flood risk management need.	Future availability and licencing arrangements of flood risk maps for other sources. Licensing arrangements for third party data layers used in the production of future datasets.	Continued work by the Environment Agency to work with its strategic partners to develop nationally available maps of flood risk from other sources (i.e. surface water, groundwater and reservoir inundation maps) which can be shared directly with professional parties. These products should incorporate detailed local information and historic data on flooding which are provided by local authorities, utilities and others.
1C	Development of national fluvial and tidal flood risk maps which delimit vulnerability for high frequency return periods	Environment Agency and others	Help improve the identification of locations/properties which were most vulnerable and thereby support effective decision making and investment planning (e.g. future funding of the Defra flood resistance/resilience grant scheme funding).	Technical complexity of modelling and confidence in the final outputs produced. Inappropriate use of the final outputs.	Continued work by the Environment Agency to work with its strategic partners to develop flood risk maps for high frequency return periods and consider appropriate methods of communicating information to users.
1D	Creation of an adapted version of the national property level dataset (based on the OS Address Layer 2) which includes the following	Environment Agency	Production of a consistent dataset which can be used by the Environment Agency and strategic partners for the future	Future availability and licencing arrangements of flood risk maps for other sources	Further work (potentially as part of the development of the Environment Agency"s National Receptor Dataset) to explore the format and requirements for this product.

Improving the collection and management of property level flood risk information					
No	**Proposed action**	**Organisations involved**	**What will be the long term benefit?**	**What are the main barriers?**	**What is the future action needed?**
	Attributes. - flood potential for a series of defined (10%, 1% and 0.1%) fluvial, coastal, surface water and groundwater flood risk events - water level information for a series of defined (10%, 1% and 0.1%) fluvial, coastal, surface water and groundwater flood risk events/flood history. - property threshold levels (where recorded) This dataset would not include VO Focus rating information to simplify licencing arrangements.		collection of information relating to property level flood risk. This would build upon an established data source used for National Flood Risk Appraisals.	Availability and accuracy of water level/depth information Availability of property level threshold data Volume of overall database and OS licensing arrangements	
1E	Consistent recording of property level flood risk information using a standardised address format. This would ideally be based upon the address structures contained within the NLPG or Ordnance Survey Addresspoint / Address Layer 2 products.	All parties collecting information relating to property level flood risk (including the insurance and survey industry)	The use of a standardised address referencing system would help to improve the future sharing and integration of information relating to property level flood risk. The OS Addresspoint / Address Layer 2 structure is integral to the Environment Agency"s National Property Dataset and many of GIS and database management systems used by central government agencies	The key barrier to this action is the established IT and data collection practices used by the organisations collecting property related flood risk information. The adoption of new method for data capture is likely to improve over time but this will be a slow and gradual process.	Further work (potentially as part of the development of the Environment Agency"s National Receptor Dataset) to explore the format and requirements for this product
1F	Explore the future use of the Environment Agency"s National Property Dataset or National Flood and Coastal Defence Database (NFCDD) to store future property	Environment Agency	Improved centralised management and use of information relating to property level flood risks	Adaptation of the existing NPD 2008 and/or NFCDD datasets could be technically challenging. Long term resource commitment to update and maintain the	Detailed consideration of the current architecture and system capabilities of these current database systems.

Improving the collection and management of property level flood risk information					
No	**Proposed action**	**Organisations involved**	**What will be the long term benefit?**	**What are the main barriers?**	**What is the future action needed?**
	level flood risk information recorded directly by government agencies (i.e. the Environment Agency, Defra and DCLG) and/or supplied by other agencies.			dataset.	
1G	Future storage of all details of all properties which have been protected by the Defra flood resistance and resilience grant scheme in a central database system – potentially using the Environment Agency NPD 2008 data structure. The information recorded should include the location, nature (i.e. type of measures installed), cost and performance of resistance and resilience measures.	Defra and the Environment Agency	The recording of this information would aid the development of more sustainable flood management strategies within the UK and potentially (subject to the owners permission) and inform the insurance industry that a home was adequately protected and therefore subject to normal insurance terms as defined under the ABI Statement of Principles. A potential extension of this proposal would be the potential for owners of residential / commercial properties with flood resistance and resilience to self register on the database. This action was also proposed in an earlier Defra research report (Defra, 2008 and Thurston et al, 2008).	Potential data protection issue relating to information held on the system and resources for managing and adding new information	Further work to identify the technical options for recording future information regarding flood resistance and resilience installations at a central level This might be facilitated through standard forms provided by installers of protection products granting (or refusing) permission to register the installation on the database.

Improving the sharing of property level flood risk information					
No	**Proposed action**	**Organisations involved**	**What will be the long term benefit?**	**What are the main barriers?**	**What is the future action needed?**
2A	Security controlled supply of claims data between the insurance industry and Government departments (Environment Agency).	ABI, insurance companies and the Environment Agency	Aid the future improvement of the Environment Agency"s flood risk maps and assessment of risk levels for detailed flood risk strategies.	Commercial concerns of some insurance companies to supply data. Need to ensure that the information is securely provided and used only for purposes of FRM and that the use of the information does not infringe the requirements of the Data Protection Act.	Further work to finalise the scope and licensing arrangements for sharing of non-sensitive information between professional partners.
2B	Direct access by the Environment Agency flood risk mapping team to relevant flood event information held on the DCLG Incident Recording System.	Environment Agency and the DCLG	Aid the future improvement of the Environment Agency"s flood risk maps and assessment of risk levels for detailed flood risk strategies.	Database has only recently gone live and further developments (including reporting capability) are still being progressed. Further work will be needed to assess the potential use of the information held in the database for Flood Risk Management purposes.	It is suggested that additional work is undertaken by government agencies (including Environment Agency, Defra and DCLG) to investigate the benefits of using the information held in the recently developed DCLG IRS system to help improve the calibration of nationally approved flood risk models and maps. This includes assessing the potential for relating the information collected within the DCLG IRS with the information contained in the Environment Agency National Property/Receptor Dataset. The delivery of this action will require future discussions between relevant specialists in the Environment Agency and the DCLG to evaluate potential arrangements for sharing of the data contained in the IRS. This will need to cover relevant data protection, technical delivery and update needs.
2C	Actions to encourage all water companies to share (where possible) relevant flood risk datasets with professional partners.	Water companies and the Environment Agency	Improved assessment of risk and development of improved property level flood risk assessments.	Reluctance by some companies to release data due to commercial and privacy concerns.	Finalisation of ongoing discussions between the Environment Agency and UK water industry to formalise future data sharing arrangements. This should link to the final responsibilities outlined in the Floods and Water Management Bill.
2D	Encourage local authorities to supply details of the location of previously flooded properties to the Environment Agency.	Local authorities	This development will assist the assessment of future FRM actions and/or development of enhanced flood risk models.	Number of local authorities involved and the format/quality of data holdings. Available resources within local authorities to collect new data or provide data to other parties. Concerns regarding potential property blight and is-use of the datasets.	Work by the DCLG and the Environment Agency to encourage the sharing and use of local authority information. This might include the development of a nationally approved memorandum of understanding regarding data sharing and licensing arrangements.

Improved access to available information					
No	**Proposed action**	**Organisations involved**	**What will be the long term benefit?**	**What are the main barriers?**	**What is the future action needed?**
3A	Use of existing internet web portal to manage metadata details of sources of property related flood risk information, including their routes to access, costs and limitations. Examples might include Project Atlantis or data.gov.uk[7] websites.	Environment Agency and Defra with contributions of other key stakeholders.	Provide a consistent structure for users to access basic details of datasets	The cost of creating a new dedicated website could be expensive. Long term resource commitment to update and maintain the dataset.	Evaluation of existing systems of metadata storage and retrieval which could be used host details of available sources of information. Examples include the Project Atlantis or data.gov.uk data sharing initiatives
3B	Increased actions by relevant professional bodies to communicate the availability of existing sources of information to their members.	Professional bodies representing stakeholders interviewed in the study.	Improve the awareness of sources of property level information and thereby enhance the assessment of flood risk issues.	Action by professional bodies to increase the awareness and use of relevant flood risk datasets.	Action by the Environment Agency to increase the awareness of Environment Agency products and commercially available environmental constraint reports via the internet. In terms of the public, communication is probably best serviced by Environment Agency Area staff who can communicate the information which is currently available. It is also proposed that a direct link is provided from the “More about flooding” section of the Environment Agency “What”s in your backyard” Flood Map to currently available Environment Agency flood risk assessment products. The provision of this link would help to increasing the awareness of currently available information relating to property level flood risk.
3C	Enhancement of the Environment Agency What"s in my backyard website to include national surface water and/or groundwater flood risk maps	Environment Agency	All professional partners and members of the public would have direct access to the information relating to flood risk from all sources.	Negotiation of licensing terms and/or costs to publish the existing maps online or development of a new set of surface water flood maps by the Environment Agency. Licensing of existing BGS maps for online publication or development of new set of groundwater flood risk maps by the Environment Agency. Interpretation of risk information could be open to misuse or mis-	Evaluation of the financial costs, licensing needs and caveats required for publication of national surface water and/or groundwater datasets via the EA website

Improved access to available information					
No	**Proposed action**	**Organisations involved**	**What will be the long term benefit?**	**What are the main barriers?**	**What is the future action needed?**
				interpretation. Potential concerns regarding quality of mapping and potential for property blight.	
3D	Development of an enhanced reporting tool on the Environment Agency What"s in my backyard website to report fluvial, coastal, surface water and groundwater risks.	Environment Agency	Professional partners and members of the public will have basic access to the information relating to flood risk from all sources.	Availability of relevant data layers and agreement for use on the Environment Agency"s website. Technical development of the tool. Interpretation of risk information could be open to misuse or mis-interpretation. Potential concerns regarding quality of mapping and potential for property blight.	Assessment of the technical options and costs for any future enhancement of the "What"s in my backyard" website reporting tool.
3E	Enhancement of the Environment Agency existing FRA products to include data layers covering other sources of flooding.	Environment Agency	Development of improved products for detailed flood risk assessment.	Availability and licensing arrangements needed to integrate surface water and groundwater layers into the FRA products Development of products which fully consider the accuracy of different surface water and groundwater layers	Availability and licensing arrangements needed to integrate surface water and groundwater layers into the FRA products. Development of products which fully consider the accuracy of different surface water and groundwater layers.
3F	Encourage individuals seeking to purchase a property in a significant flood risk area to obtain a detailed flood risk report	Property professional – including property conveyance solicitors, mortgage lenders and Estate Agents	This greater use of these reports would help to clarify the flood risk issues at an early stage of the selling process, and potentially avoid unnecessary costs for both parties later in the process.	Obtaining a detailed flood risk report is not a current legal requirement of the property sale process Potential cost of report but relatively small compared to the average house price sale	Additional efforts to communicate the benefits of obtaining a detailed flood risk report for property transactions in significant flood risk areas. Efforts particularly aimed at property professionals - including property conveyance solicitors, mortgage lenders and Estate Agents.

Improved access to available information					
No	**Proposed action**	**Organisations involved**	**What will be the long term benefit?**	**What are the main barriers?**	**What is the future action needed?**
3G	Development of spatial data layers which detail (a) all areas (rather than some) which currently benefit from flood defences and (b) locations where defences are currently being built.	Environment Agency	These layers were seen alongside improved mapping of other sources of flooding (including surface water, groundwater and reservoir failure) as the most important requirements for the future assessment of risk to individual properties. It is also suggested that future efforts are directed (where possible) at increasing the availability of these sources of information for professional partners. Insurance companies would like to access this type of information and development of these data layers could benefit a variety of other users – including local authority	Future availability and currency of this information	Further work to consider the benefits and costs of developing this spatial dataset

Appendix C-2: Full list of suggested actions

EA, 2010, p, 8 to 10.

Principle 1: Mapping of flood and coastal risk from all sources will be available from one place

We will:

A1.1 ensure mapping of flood and coastal risk developed by others, where it meets our standards, can be accessed alongside our own mapping;

A1.2 present the information on flood risk and coastal erosion in a way that helps people to understand the risks, and where appropriate take action.

Principle 2: Our mapping, to meet a diverse set of needs, will be based on a consistent approach and a single set of data

We will:

A2.1 update our current National Flood Risk Assessment (taking a probabilistic approach) using improved data and methods, where appropriate, and include more detailed, local mapping in higher risk areas (using the same probabilistic approach). This will be our primary source of data to communicate flood risk;

A2.2 replace the Flood Map with mapping developed using probabilistic methods;

A2.3 review and update the data, method and types of coastal erosion covered, to improve this mapping, where appropriate;

A2.4 stop using the Flood Zones as our primary source for communicating the chance of flooding to the public, but continue to use it to support local planning authorities in their development planning role (to support Planning Policy Statement 25 in England and, through Development Advice Maps, Technical Advice Note 15 in Wales);

A2.5 take a risk-based approach to collecting and maintaining this information, including its quality and detail, that focuses on meeting both our needs and those of our partners and customers;

A2.6 continue to record information on flooding from rivers and the sea.

Principle 3: Uncertainty (including climate change) will be addressed in our mapping

We will:

A3.1 use uncertainty in a positive way as part of the way we communicate flood and coastal erosion risk and make decisions;

A3.2 work with our partners and customers to ensure we display uncertainty in ways that make it most understandable to them;

A3.3 map climate change and present this information in a way that helps us plan for the future.

Principle 4: A greater range of the impacts of flooding and coastal erosion, and the risk of flooding to a property level, will be considered

We will:

A4.1 develop a dataset that will include information about the sites affected by flooding and coastal erosion, including properties, significant environmental sites and sites of cultural interest. This dataset will be the single source which we will use to understand the impacts of flood and coastal risk;

A4.2 investigate whether we can realistically assess risk to the property level in a cost-effective way, and, if so, determine whether we need to take a risk-based approach to the application of that method.

Principle 5: Our methods will give us a broader picture of risk and will be used by our partners

We will:

A5.1 work with our partners to produce guidance on using the outputs of our improved methods to map flood risk for all sources of flooding, and encourage adoption of this guidance;

A5.2 work with our partners and customers to ensure that, guided by research, we present the information on flood risk from all sources of flooding in a way that shows flood risk more intuitively;

A5.3 meet requirements for depth and velocity mapping (formerly termed hazard mapping) through our improved method of mapping;

A5.4 make sure that the way these new methods calculate risk is clearly understood and transparent to the users.

Principle 6: Where appropriate, we will advise our partners on mapping of flooding from all sources including those sources for which they are the lead organisation

We will:

A6.1 work with our partners to produce guidance, standards and, where appropriate, tools for risk assessment of flooding for sources for which we are not the lead organisation. We will encourage our partners to adopt these documents;

A6.2 maintain a national dataset of historic flooding from all sources, using information collected and recorded by our partners to our standards.

Principle 7: We will regularly review what we present and how it is being used

We will:

A7.1 be clear what is the intended use of any information we present;

A7.2 regularly review the uses of the information we create, maintain and provide, and assess whether the needs of those using it have changed, or if there are new uses for it;

A7.3 accept that needs do change, and respond to these changes, either through support and guidance or by providing new products where appropriate.

Principle 8: Information will be published promptly and responsibly

We will:

A8.1 ensure information meets identified needs before it is published;

A8.2 work with our partners to ensure the most appropriate organisation publishes the information;

A8.3 endeavour to highlight where information we provide has changed, and make available the reasons for those changes.

Appendix C-3: List of Working Group 2: Data provision and transparency summary of recommended actions.

DEFRA, 2011, p.20.

1. The Environment Agency to investigate whether they can communicate details of the geographic locations of NaFRA updates to insurers in advance of them actually appearing on the dataset.

2. The Environment Agency to investigate whether a timetable can be introduced, according to which updates will be shown on the online NaFRA map and the NaFRA dataset that is shared with insurers.

3. Defra and all Working Group 2 member organisations to promote the Environment Agency's letter-writing service when responding to correspondence from MPs and members of the public regarding assessment of flood risk.

4. Defra to commission a research project to look at incorporating localised flood risk information into insurers' underwriting and to set up a project board including members of Working Group 2.

5. The ABI and Environment Agency to continue to work together towards sharing flood extent and claims data.

6. Defra to publish and maintain the flood and coastal erosion risk information factsheet, keeping it up to date and available for members of the public and other organisations to access.

7. Defra and the Environment Agency to set up a project board to improve the communication and categorisation of flood risk, with an advisory panel including Working Group 2 members.

8. Defra and the Environment Agency to work together to make flood risk datasets more transparent and accessible.

Appendix C-4: List of Working Group 3: Customer experience and perspectives towards property-level resistance and resilience summary of recommended actions.

DEFRA, 2011, p. 30.

1. Members of the Working Group to work towards developing a 'standard of protection' for property-level measures through:

a. Setting up a sub-group to consider whether and how a standard of protection could be applied in practice, using examples from previous and current property-level grant scheme and from the Lower Thames flood risk management strategy. The sub-group will be led by Defra, with involvement from the Environment Agency, ABI and BIBA

b. Defra commissioning a research project to improve property-level data and consider how it could be used to inform a standard of protection for property-level measures (see Working Group 2, action 4).

2. Defra and the Environment Agency to involve relevant Working Group 3 members in the evaluation of the property-level grant scheme and in developing policy on future funding of resistance and resilience.

3. Defra, the Environment Agency, ABI and BIBA to develop understanding of how a 'standard of protection' could be specified for property-level measures (see action 1).

4. ABI and BIBA to work with Defra to develop evidence around effectiveness and impact of property-level measures, so that these measures may be taken into account by insurers in the future.

5. The National Flood Forum and the ABI to discuss specific examples of obstacles to resilient reinstatement.

6. Defra to investigate scope and practicality for a resilient repair pilot project, in consultation with other Group members.

7. Defra and CLG to reflect the comments of Working Group 3 in work on the National Planning Policy Framework (NPPF). Working Group members will have an opportunity to comment on the draft NPPF in a forthcoming consultation.

8. Working Group 3 members to review the information they provide to the public and local authorities in light of the findings of the Working Group, in particular:

a. Local Government Group to use their portal as a means for local authorities to share information and access advice on resistance and resilience

b. Working Group 3 to link up with Lincolnshire project on resistance and resilience as a means of sharing case studies more widely

c. Insurers and loss adjustors to continue to make customers aware of resistance and resilience options post-flood, including through a new factsheet developed by CILA and the National Flood Forum

d. Environment Agency to review information available on its website