

BRIDGES OVER TROUBLED WATERS: AN INTERDISCIPLINARY FRAMEWORK FOR EVALUATING THE INTERCONNECTEDNESS WITHIN FRAGMENTED DOMESTIC FLOOD RISK MANAGEMENT SYSTEMS

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Diversification of strategies in flood risk management (FRM) is widely regarded as a necessary step forward in terms of reducing the likelihood and magnitude of flooding, as well as minimising the exposure of people and property and, in turn, the disruption, economic damage, health impacts and other adverse consequences that ensue when floods occur. Thus, diversification is often heralded as an essential condition for enhancing societal resilience to flooding. However, an inevitable consequence of diversifying strategies and practices in FRM is that it can lead to fragmentation within FRM systems, in terms of the distribution of responsibilities between actors and governing rules enacted within different policy domains. This can prove detrimental to the effectiveness of FRM. Building upon the notion of fragmentation developed in legal and governance literature, this article introduces the concept of 'bridging mechanisms', ie instruments that remedy fragmentation by enhancing interconnectedness between relevant actors through information transfer, coordination and cooperation. This article develops a typology of both fragmentation and bridging mechanisms and analyses their relations, partly drawing upon empirical research conducted within the EU 'STAR-FLOOD' Project. In turn, this article outlines a novel interdisciplinary methodological framework for evaluating the degree and quality of the interconnectedness within fragmented domestic FRM systems. A pragmatic, flexible and broadly applicable tool, this framework is suited for both academic purposes and for practically oriented analysis and (re)development of fragmented FRM systems, and potentially other fragmented systems, within the EU and abroad.

1 INTRODUCTION

EU policy and legislation on flood risk management (FRM) aim at the reduction of the adverse consequences of floods for human health, the environment, cultural heritage and economic activity.⁴ In order to achieve this central aim, in

the literature five potential strategies have been distinguished, namely *prevention*, *defence*, *mitigation*, *preparation and response*, and *recovery* following floods.^{5,6} Defence and mitigation strategies reduce the likelihood and magnitude of flooding through the use of measures that act to resist (eg dykes) or accommodate (eg flood storage areas, adaptive building) water, respectively.⁷ Accompanying this, the prevention strategy aims to minimise the exposure of people and property to flooding, for example, through the use of spatial planning conditions (eg building restrictions).⁸ At a time where it must be accepted that not all floods can be prevented everywhere, the strategies for preparation and response and recovery employ a range of measures that aim to reduce the adverse consequences that ensue when floods occur, such as emergency management and insurance or compensation mechanisms, respectively.⁹

It has generally been assumed that effectively implementing each of the five FRM strategies and moving beyond defence-dominated approaches – also referred to as *diversification* – increases societal resilience to flooding.¹⁰

J I Barredo 'Major flood disasters in Europe: 1950–2005' (2007) 42(1) *Natural Hazards* 125–48.; H F M W van Rijswijk H J M Havekes *European and Dutch Water Law* (Europa Law Publishing 2012); and H K Gilissen 'The integration of the adaptation approach into EU and Dutch legislation on flood risk management' (2014) 24(3/4) *Journal of Water Law* 157–65.

5 See S Meijerink, W Dicke 'Shifts in the public–private divide in flood management' (2008) 24(4) *International Journal of Water Resource Development* 499 at 500–501; Van Rijswijk and Havekes(n 4) 251; and D L T Hegger, P P J Driessen, C Dieperink, M Wiering, G T T Raadgever and H F M W van Rijswijk 'Assessing stability and dynamics in flood risk governance: an empirically illustrated research approach' (2014) 23(12) *Water Resources Management* 4127 at 4127–28. All FRM strategies contribute to the achievement of the central aim through specific types of measures. The flood risk prevention strategy, for instance, can be implemented through restrictive land-use policies (eg 'construction bans' for flood prone areas), whereas a typical example of a defence measure is the construction of a dike. There is no hierarchical relation between FRM strategies (at least not on the basis of EU policy and legislation); Member States are left much policy discretion as to the decision on which strategies to implement and how they do so within their domestic FRM frameworks.

6 Note that the Floods Directive discerns only three out of five strategies: prevention, protection (defence) and preparation. See COM(2004) 472 at 4 and FD preamble Consideration 14.

7 See Hegger and others (n 5).

8 *Ibid.*

9 See H K Gilissen, M Alexander, P Matczak, M Pettersson and S Bruzzone 'A framework for evaluating the effectiveness of flood emergency management systems in Europe', *Ecology and Society* 2016; and C Suykens, S Priest, W van Doorn-Hoekveld, T Thuillier and M van Rijswijk 'Dealing with flood damages: will prevention, mitigation and ex-post compensation provide for a resilient triangle?', *Ecology and Society* 2016.

10 See J C J H Aerts, W Botzen, A van der Veen, J Krywkow and S Werners 'Dealing with uncertainty in flood management through diversification' (2008) 13(1) *Ecology and Society* 41–57; D L T Hegger, C Green, P P J Driessen, M Bakker, C Dieperink, A Crabbé, K Deketalaere, B Delvaux, C Suykens, J C Beyers, M Fournier, C Larrue, C Manson, W J van Doorn-Hoekveld, H F M W van Rijswijk, Z W Kundzewicz and S Goytia Casermeiro, *Flood Risk Management in Europe: Similarities and*

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3 This article has been written in the framework of the European Union's Seventh Programme for Research, Technological Development and Demonstration within the STAR-FLOOD Project (www.starflood.eu).

4 See COM(2004) 472 and Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks (Floods Directive or FD) art 1. See also

Research into domestic FRM systems shows that diversification is institutionalised to varying degrees throughout the EU.¹¹ However, such diversification has resulted in different degrees of *fragmentation*, with FRM strategies implemented through different policy domains and by various actors with different responsibilities and competences.¹² The assumption upon which this article builds, then, is that enhancing *interconnectedness* within a fragmented FRM system (ie creating or intensifying interactions between all relevant actors) is essential to cope with the difficulties relating to fragmentation, and thus will benefit the effectiveness of FRM.¹³

The specific instruments through which this is done are referred to in this article as *bridging mechanisms*.¹⁴ Indeed, a wide range of (types of) bridging mechanism can be discerned throughout the EU, mostly aimed at sharing information, coordination of policies and cooperation. Although specific examples of bridging mechanisms, such as the ‘water test’ or other similar instruments have already been examined in (domestic) literature,¹⁵ there is not yet

a consistent typology nor a coherent framework for the evaluation of the desirable effects and effectiveness of such instruments. This article contributes to their development.

For this purpose, this article builds upon results of cross-disciplinary research carried out within the ‘STAR-FLOOD’ Project, which examined flood risk governance arrangements across six EU Member States,¹⁶ from legal, public administration and policy perspectives. It draws from the results of qualitative analysis of domestic FRM governance arrangements and positive legal analysis of relevant primary and secondary legal sources. These findings were further enriched by semi-structured interviews with past and present FRM experts, analysed according to qualitative thematic analysis.¹⁷

On the basis of this rich body of data and further theoretical reasoning, this article first introduces a typology of and elaborates upon the concept of fragmentation and its related difficulties (section 2). Thereafter, the article addresses the concepts of bridging mechanisms and interconnectedness (section 3). Empirical data concerning the degrees and types of fragmentation and bridging mechanisms are presented in section 4 by virtue of an exemplification of the previous sections. Addressing a knowledge gap and for the purpose of facilitating future (comparative) research, section 5 of this article outlines a novel interdisciplinary methodological framework for structured in-depth evaluations of the degree and quality of interconnectedness within fragmented domestic FRM systems. The article concludes with key findings and an open invitation for future research (section 6).

2 FRAGMENTATION

The concept of fragmentation has been the focus of international legal research for almost two decades.¹⁸ Soon

Differences Between the STAR-FLOOD Consortium Countries (Report no D1.1.4) STAR-FLOOD Consortium (2013) 4127–28; C Larrue, D L T Hegger and J B Trémorin (eds) *Researching Flood Risk Governance in Europe: A Framework and Methodology for Assessing Flood Risk Governance* (Report no D2.2.1) STAR-FLOOD Consortium (2013); C Larrue, D L T Hegger and J B Trémorin (eds) *Researching Flood Risk Governance in Europe: Background Theories* (Report no D2.2.2), STAR-FLOOD Consortium (2013); and Hegger and others (n 5).

11 See M Alexander, S Priest, A P Micou, S Tapsell, C Green, D Parker and S Homewood *Analysing and Evaluating Flood Risk Governance in England: Enhancing societal resilience through comprehensive and aligned flood risk governance* (Report no D3.3) STAR-FLOOD Consortium (2015); K Ek, S Goytia, M Pettersson and E Spegel *Analysing and Evaluating Flood Risk Governance in Sweden: Adaptation to Climate Change?* (Report no D3.5) STAR-FLOOD Consortium (2015); M Kaufmann, W J van Doorn-Hoekveld, H K Gilissen and H F M W van Rijswijk *Analysing and Evaluating Flood Risk Governance in the Netherlands: Drowning in Safety?* (Report no D3.2) STAR-FLOOD Consortium (2015); C Larrue, S Bruzzone, L Lévy, M Galepois, T Schellenberger, J-B Trémorin, M Fournier, C Manson and T Thuillier *Analysing and Evaluating Flood Risk Governance in France: From State Policy to Local Strategies* (Report no D3.7) STAR-FLOOD Consortium (2015); P Matczak, J Lewandowski, A Choryński, M Szwed and Z W Kundzewicz *Analysing and Evaluating Flood Risk Governance in Poland: Looking for Strategic Planning in a Country in Transition* (Report no D3.6) STAR-FLOOD Consortium (2015); and H Mees, C Suykens, J C Beyers, A Crabbé, B Delvaux and K Deketelaere *Analysing and Evaluating Flood Risk Governance in Belgium: Dealing with Flood Risks in an Urbanized and Institutionally Complex Country* (Report no D3.4) STAR-FLOOD Consortium (2015).

12 None of the selected countries has implemented a specific combination of FRM strategies into one fully integrated ‘governance arrangement’ with a clearly demarcated set of actors, rules and resources. Most domestic FRM systems comprise a number of distinct (sub-)arrangements instead. For further reading see D Liefverink ‘The dynamics of policy arrangements: turning round the tetrahedron’ in B Arts, P Leroy (eds) *Institutional Dynamics in Environmental Governance* (Springer 2006) 45–68; and Larrue and others (eds) *Researching Flood Risk Governance in Europe: Background Theories* (n 10).

13 See eg P Matczak, M Wiering, J Lewandowski, T Schellenberger, J-B Trémorin, A Crabbé, W Ganzevoort, M Kaufmann, C Larrue, D Liefverink and H Mees *Comparing Flood Risk Governance in Six European Countries: Strategies, Arrangements and Institutional Dynamics* (Report no D4.1) STAR-FLOOD Consortium (2016) 33–34.

14 The term ‘bridging mechanisms’ has emerged within the framework of the STAR-FLOOD Project. Within this project, different approaches to this notion have been developed (see eg Matczak and others (n 13) 33–34). On first glance, these seem to differ greatly. Nonetheless, these approaches have the same conceptual basis and are not internally contradictory; rather, they are to be treated as ‘different views of the cathedral’.

15 See eg F A G Groothuise, H F M W van Rijswijk ‘Water en ruimtelijke ordening: méér dan de watertoets! (I and II)’ (2005) 3 *Bouwwrecht* 193–210, 384–401; F A G Groothuise *Water weren – Het publiekrechtelijke instrumentarium voor de aanpassing en bescherming van watersystemen ter voorkoming en beperking van wateroverlast en overstromingen* (dissertation Utrecht University) Instituut voor Bouwwrecht (2009); Van Rijswijk and Havekes (n 4); M Denys, J Toury ‘Vernieuwde

watertoets. Vergoedingsregeling bij bouw- en verkavelingsverbod’ (2012) 256 *NjW* 82–92; J Ameloot ‘De vereenvoudiging van de watertoets’ (2013) 3 *TBO* 99–107; A Carette, P de Smedt ‘Het vernieuwde decreet integraal waterbeleid: Sneller en beter?’ (2013) 56 *TMR* 576–602; H K Gilissen, J Kevelam and H F M W van Rijswijk *Water en ruimte – De bescherming van watersysteembelangen in het ruimtelijk spoor* (2nd fully rev edn Berghauser Pont Publishers 2014); Organisation for Economic Co-operation and Development (OECD) *Water Governance in the Netherlands: Fit for the Future?* OECD Studies on Water (OECD Publishing 2014); H F M W van Rijswijk ‘Water en ruimtelijke ordening: wat brengt de toekomst?’ in R C J Cremers, E R Hijmans, Y Hinnen, A M Jansen and W H E Parlevliet (eds) *Terecht Bouwwrecht* (Kluwer 2014) 277–305; Kaufmann and others (n 11); Mees and others (n 11); Alexander and others (n 11); Larrue and others (n 11); and Matczak and others (n 11).

16 The Member States participating in this project were Belgium, the UK, France, the Netherlands, Poland and Sweden. Sweden, for practical reasons, was excluded from this article. The remaining countries, hereinafter, are referred to as ‘the selected countries’.

17 See C Cassell, G Symon (eds) *Essential Guide to Qualitative Methods in Organizational Research* (Sage Publications 2004).

18 See eg G Hafner ‘Risks ensuing from fragmentation of international law’ *Official Records of the General Assembly, Fifty-fifth Session* (2000), Supplement No 10 (A/55/10); M Koskeniemi, P Leino ‘Fragmentation of international law? Postmodern anxieties?’ (2002) 15(3) *Leiden Journal of International Law* 553–79; G Hafner ‘Pros and cons ensuing from fragmentation of international law’ (2004) 25(4) *Michigan Journal of International Law* 849–63; International Law Commission (ILC) *Fragmentation of International Law: Difficulties Arising from the Diversification and Expansion of International Law* UN Doc A/CN.4/L.682 (2006); A C Martineau ‘The rhetoric of fragmentation: fear and faith in international law’ (2009) 22(1) *Leiden Journal of International Law* 1–28; and O K Fauchald, A Nollkaemper (eds) *The Practice of International and National Courts and the (De-)Fragmentation of International Law* (Hart Publishing 2012).

after its emergence, this concept was also adopted by other disciplines, such as global (environmental) governance.¹⁹ Fragmentation is commonly defined as the situation in which a 'governance architecture' is not regulated or dominated by a single (international) regime,²⁰ but instead is 'marked by a patchwork of international institutions that are different in their character (organizations, regimes, and implicit norms), their constituencies (public and private), their spatial scope (from bilateral to global) and their subject-matter (from specific policy fields to universal concerns)'.²¹

Fragmentation, at first, had a negative connotation, as it was argued it could, for instance, lead to legal uncertainty, threats to the 'credibility, reliability and, consequently, authority of international law', and could negatively affect its effectiveness.²² Over time, most of this negativity was soothed. The consequences of fragmentation were rather framed as 'difficulties' or 'challenges' instead of 'problems' or 'risks', and fragmentation itself was viewed as an inevitable result of intrinsically positive developments, such as diversification and expansion of (international) regimes.²³

Unsurprisingly, most global governance architectures are fragmented, although the degree of fragmentation is varied.²⁴ Less frequently, the concept of fragmentation is cut loose from its international environment and – in a somewhat or heavily altered form – transplanted into an EU, domestic or regional context.²⁵ Also, at these levels different degrees and types of fragmentation seem to be omnipresent. This article is situated within this context

19 See eg S Bernstein, M Ivanova 'Institutional fragmentation and normative compromise in global environmental governance: what prospects for re-embedding?' in S Bernstein, L W Pauly (eds) *Global Liberalism and Political Order: Towards a New Grand Compromise?* (State University of New York Press 2007) 161–85; F Biermann, P Pattberg, H van Asselt and F Zelli 'The fragmentation of global governance architectures: a framework for analysis' (2009) 9(4) *Global Environmental Politics* 14–40; F Zelli 'The fragmentation of the global climate governance architecture' (2011) 2(2) *WIREs Climate Change* 255–70; and F Zelli and H van Asselt 'The institutional fragmentation of global environmental governance: causes, consequences, and responses' (2013) 13(3) *Global Environmental Politics* 1–13.

20 The term 'global governance architectures' is nowadays a key term in literature about fragmentation. It is defined as 'the overarching system of public and private institutions that are valid or active in a given issue area of world politics. This system comprises organizations, regimes, and other forms of principles, norms, regulations, and decision-making procedures'. See Biermann and others (n 19) 15.

21 See Biermann and others (n 19) 16.

22 See Hafner (n 18) quotation at p 147, *Yearbook of the ILC* (2000); M Ambrus, H K Gilissen and J J H van Kempen 'Public Values in water law: a case of substantive fragmentation?' (2014) 10(2) *Utrecht Law Review* 8–30; and L J Kotzé 'Fragmentation revisited in the context of global environmental law and governance' (2014) 131(3) *South African Law Journal* 548–82.

23 See B Simma 'Fragmentation in a positive light' (2004) 25 *Michigan Journal of International Law* 845–48. This 'neutral' approach is also at the basis of this article.

24 See Biermann and others (n 19) 17–18. Biermann and others distinguish between three degrees of fragmentation (ibid 19–21): synergistic fragmentation (high level of integration), cooperative fragmentation (more loosely integrated), and conflictive fragmentation (no integration). In this respect, 'full integration' can be seen as the opposite of fragmentation.

25 See eg J Edler and S Kuhlmann 'Coordination within fragmentation: governance in knowledge policy in the German federal system' (2008) 35(4) *Science and Public Policy* 265–76; K Bakker and C Cook 'Water governance in Canada: Innovation and fragmentation' (2011) 27(2) *International Journal of Water Resources Development* 275–89; and Ambrus and others (n 22).

and focuses on the degree (section 2.1) and types (section 2.2) of fragmentation evident in domestic FRM systems in selected EU Member States.

2.1 The degree of fragmentation

In order to obtain a better view of fragmentation, one of this article's key concepts, it is necessary to define a number of its central terms. For the purpose of this article, a *flood risk management (FRM) system* is conceptualised as the overarching domestic institutional system, comprising all (types of) actors, values, principles, norms, rules, regulations and procedures relating to flood risk management.²⁶ Flood risk management, in turn, refers to all (types of) activities that address the exposure, hazard and consequences of flood risk, enacted through the five FRM strategies previously mentioned.²⁷ The key players within FRM systems – in this article referred to as *actors* – can be public or private entities, organisations, departments, groups or even individuals that have been assigned a specific set of FRM-related responsibilities and competences, either legally established through statutes or custom or encouraged through public policy. Hence, actors are primarily to be distinguished by their specific responsibilities and competences in their pursuit of certain FRM strategies.

All actors contribute to the achievement of the same overall objective (ie effective FRM), but they can only make use of the specific competences and instruments at their disposal, and they can only be held legally accountable for the fulfilment of the specific tasks that have been allocated to them. The *degree* of fragmentation of an FRM system could, therefore, be determined by assessing the quantity of actors involved with distinct responsibilities and competences in the pursuit of FRM strategies. If all responsibilities and competences relevant to FRM – in a hypothetical situation – are assigned to a single omnipotent actor, the system is not fragmented, but fully integrated. The more that actors have closely related or even overlapping responsibilities and competences in the pursuit of FRM strategies, the higher the degree of fragmentation (see Figure 1). However, this does not say much about the *types* of fragmentation and their related difficulties (see section 2.2).

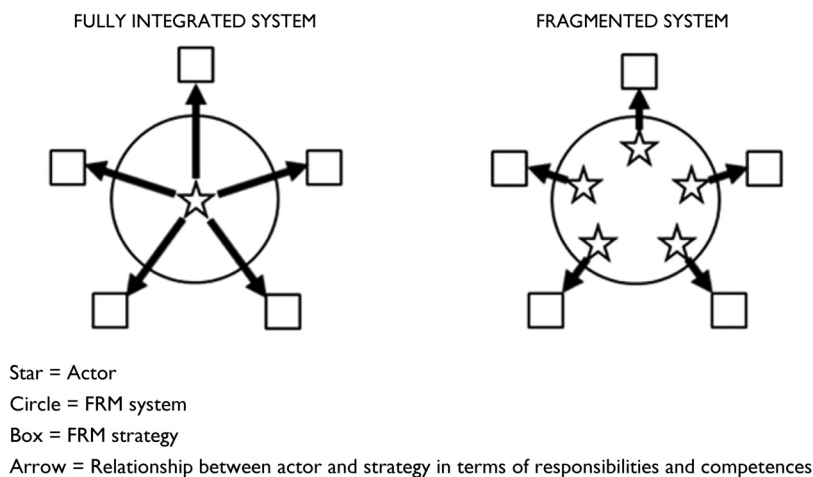
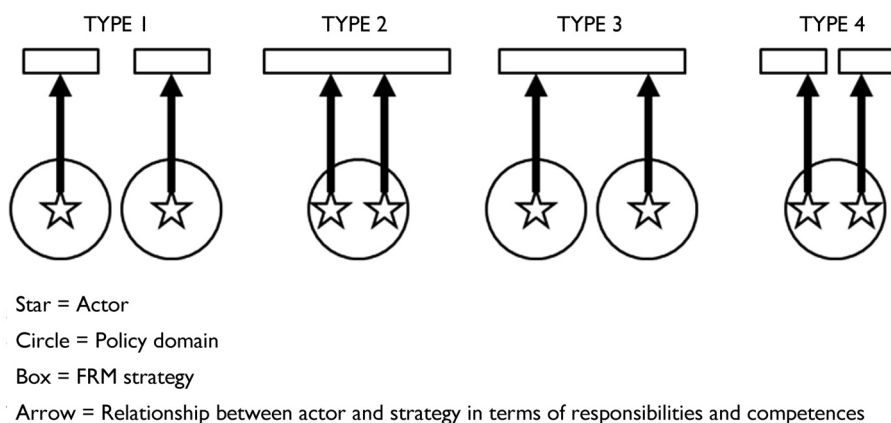
2.2 Four types of fragmentation

Distinguishing types of fragmentation adds much complexity to this concept, but is necessary for the purpose of this article. Analysing the *degree* of fragmentation could, after all, only determine the number of bridging mechanisms needed and their preferred points within the FRM system (ie the *degree* of interconnectedness within an FRM system; see section 3.2). Determining the *type* of fragmentation could ascertain whether there is a relation between specific types of bridging mechanisms and specific types of fragmentation, which is far more informative, as this is useful for evaluating the *quality* of the interconnectedness within FRM systems (see section 3.3).

26 This definition is – not coincidentally – based on the term 'global governance architectures'. See Biermann and others (n 19) 15.

27 These are, hereinafter, in short referred to as (1) prevention, (2) defence, (3) mitigation, (4) preparation and response and (5) recovery. See Van Rijswijk and Havekes (n 4) 251 and Hegger and others (n 5).

Figure 1: Fully integrated as opposed to fragmented (FRM) systems

Figure 2: Four types of fragmentation²⁸

Based on the policy domains in which actors operate²⁹ and the FRM strategies they pursue, a distinction can be made between four basic types of fragmentation. These are schematically depicted in Figure 2.³⁰

These four types of fragmentation, hereinafter, are referred to as 'type 1', 'type 2', 'type 3' and 'type 4' fragmentation, respectively. These four types are explained below and illustrated through simple examples. It should be borne in mind, however, that these types of fragmentation represent the most simplified situations possible, which are based on sets of two actors. In practice, combinations of fragmentation types are present and regularly multiple (sets of) actors are involved. In fact, every fragmented FRM system could be considered a complex combination of fragmentation types.

²⁸ Note that the circle in Figure 2 represents a policy domain, where in Figure 1 it represents an FRM system.

²⁹ A policy domain is defined as a delimited and coherent institutional system of actors, values, principles, norms, regulations and procedures, and – for the specific purpose of this article – in which actors bear certain responsibilities and competences relating to one or more FRM strategies. Note the similarities and differences between the definitions of the terms 'FRM system' and 'policy domain'. Indeed, there is a close relation between both concepts. The FRM system of a country is constituted by all distinct policy domains in which actors bear responsibilities and competences relating to FRM. Most countries' FRM systems are not policy domains in themselves, as they lack institutional delimitation and coherence and are 'scattered' over different policy domains.

³⁰ Approaching the concept from a different perspective, this distinction essentially differs from the one Biermann and others (n 19) make.

Type 1 fragmentation refers to situations in which distinct actors operating in different policy domains pursue different FRM strategies:

Example: Water management authority A operates within the distinct water resources management domain and pursues the defence strategy. Spatial planning authority B operates within another domain (spatial planning) and pursues mitigation strategy.

Type 2 fragmentation refers to situations in which distinct actors operating in the same policy domain pursue the same FRM strategy.

Example: Emergency management authority C operates within the emergency management policy domain and pursues preparation and response strategy. At the same time, emergency service D and utility provider E also operate within that domain and have certain responsibilities in the pursuit of the preparation and response strategy.

Type 3 fragmentation refers to situations in which distinct actors operating in different policy domains pursue the same FRM strategy.

Example: Water management authority F and emergency management authority G operate within different policy domains (water resources management and emergency management, respectively). Nonetheless, within the framework of those distinct domains, they have specific responsibilities and competences in the pursuit of the preparation and response strategy.

Type 4 fragmentation refers to situations in which distinct actors operating in the same policy domain pursue different FRM strategies.

Example: Water management authority H and spatial planning authority I operate within one overarching policy domain ('Management of the Living Environment'). Nonetheless, the one bears responsibility for the pursuit of the defence strategy only, whereas the other is exclusively responsible for mitigation.

3 BRIDGING MECHANISMS AND INTERCONNECTEDNESS

As discussed above, this article builds upon the assumption that enhancing interconnectedness within fragmented FRM systems (ie creating or intensifying effective inter-relations between relevant actors at relevant points within the system) benefits the effectiveness of FRM.³¹ The instruments used for this purpose are referred to here as bridging mechanisms. The term bridging mechanisms is conceptualised as all kinds of inter-linkages between sets of actors, aiming to intensify interactions in their pursuit of various FRM strategies in order to cope with the difficulties relating to fragmentation. As these difficulties are varied, different types of bridging mechanisms can also be distinguished (section 3.1). Apart from having proper types of bridging mechanisms in place at relevant points within an FRM system, bridging mechanisms should also be effective themselves in order to foster the effectiveness of FRM. In other words, both the *degree* (section 3.2) and the *quality* (section 3.3) of interconnectedness are important indicators for the effectiveness of fragmented FRM systems, and thus constitute a basis for the evaluation of such systems.

3.1 Three types of bridging mechanisms

As bridging mechanisms have been defined as inter-linkages between actors in order to cope with the potential difficulties relating to fragmentation, it is of primary importance to identify and specify these potential difficulties. In this respect, three types of situations can immediately be discerned. These are: (1) situations in which the one actor lacks and the other actor has information or experience which is needed for policy-making in the pursuit of a specific FRM strategy for which the former actor is responsible; (2) situations in which the policies of an actor in the pursuit of a specific FRM strategy can hinder another actor in the pursuit of the same or another strategy (or otherwise (negatively) influence its policy-making); and (3) situations in which actors pursue the same FRM strategy, whilst on the basis of their distinct competences none of them is capable of achieving their goal without the efforts of the other.

Having identified these three types of difficulties, a next step is to identify 'solutions' that can mitigate their adverse effects. This leads to the identification of three types of bridging mechanisms (see Table 1). A lack of information or experience requires information flows from the actor who has the relevant information towards the actor who needs this information in order to make a proper and well informed (policy) decision. These types of bridging

Table 1: Types of difficulties relating to fragmentation and types of bridging mechanisms for resolving these difficulties

<i>Type of difficulty</i>	<i>Type of bridging mechanism</i>
Lack of relevant information/experience	Transfer
One policy can hinder another	Coordination
Mutual dependency in goal achievement	Cooperation

mechanisms, in this article, are referred to as information and/or experience transferring mechanisms or, in brief, *transfer* mechanisms.³² The second difficulty requires some kind of alignment between the policies of both actors, in order to keep them both informed about their performance of duties, preventing their policies from being at odds and/or becoming impossible to implement. Such bridging mechanisms are referred to as *coordination* mechanisms.³³ In the third situation-type, both actors are dependent on each other for achieving their shared goals, which leads to the need for joint policies and/or working or, in terms of this article, the need for *cooperation* mechanisms.³⁴ It should be borne in mind that, in practice, these types of bridging mechanisms can have many different aspects,³⁵ regarding both their degree of formality, their intensity and their form of interaction.

As a closing remark, whilst bridging mechanisms aim to mitigate the (inevitable) difficulties relating to fragmentation, it should be borne in mind that there are also other ways to resolve fragmentation. These do not aim at 'managing its symptoms' through creating or intensifying interactions between actors, but at combating the degree of fragmentation itself. Such interventions do not meet the definition of bridging mechanisms presented in this article and should therefore not be considered as such. Nonetheless, they are worth mentioning, because they are to be considered as potential additional or even alternative strategies in coping with fragmentation and, in practice, provide some interesting examples.³⁶ In particular, one

32 Transfer mechanisms can have 'one-way' or 'two-way' (or even 'multiple-way') effects, aiming at information transfer or exchange respectively. Examples of transfer mechanisms are inter-organisational communication and other information-sharing or exchange structures, such as shared databases or maps, but also consulting or advisory mechanisms.

33 Examples of coordination mechanisms are (general or specific) duties to align policies, duties to take certain policies into account in other policy or decision-making procedures, but also vertical (top-down) steering mechanisms, such as inter-governmental instructions.

34 Examples of cooperation mechanisms are (general or specific) duties to cooperate, inter-governmental agreements, shared policies, covenants, and joint working structures.

35 One could even think of 'combined mechanisms', such as mechanisms that aim at both generating information flows and cooperation between actors.

36 A clear example is the Dutch Environmental Planning Act, which is scheduled to enter into force by 2018. This Act integrates a number of policy domains (eg water management, spatial planning, environmental protection, archaeology and monuments conservation) into one legal and policy framework. There will still be several actors responsible for specific aspects of environmental protection in a broad sense, but this Act also provides for the possibility to formulate shared objectives referred to as '*omgevingswaarden*'. The entry into force will not lead to a fully integrated FRM system, but (in terms of this article) will effectuate a shift from type 1 fragmentation to type 4 fragmentation. For closer reading, see eg J A E Nijenhuis 'De grote voordelen van de Omgevingswet' (2014) 162 *Tijdschrift voor Bouwrecht* 920–25 and T Nijmeijer 'Naar een stelselherziening in het omgevingsrecht: het wetsvoorstel Omgevingswet: De hoofdlijnen en de belangrijkste doelstellingen op een rij' (2014) 12 *Ars Aequi* 902–11.

31 See eg Matczak and others (n 13) 33–34.

can think of three types of systemic changes. These are: (1) the integration of policy domains; (2) the integration of strategies, for instance by adopting overarching standards; and (3) the transferal of tasks, responsibilities and competences from one actor to another.³⁷ The former two interventions mainly induce a shift from the one type of fragmentation to another, whereas the latter actually reduces the degree of fragmentation.

3.2 The degree of interconnectedness: are proper types of bridging mechanisms present at relevant points?

After having identified three types of bridging mechanisms, the degree of interconnectedness needs to be addressed. The degree of interconnectedness of a fragmented FRM system can be considered optimal if all proper types of bridging mechanisms are present at all relevant points within the system. Relevant points can easily be determined through identifying all actor sets within a system; these are the points on which difficulties relating to fragmentation potentially emerge, because actors 'meet' each other there. The main question, therefore, remains which types of bridging mechanisms are to be considered appropriate under specific circumstances. Whereas these specific circumstances are mainly determined by the types of fragmentation and their related potential difficulties, Table 2 gives an overview of the types of bridging mechanisms that should be present at a relevant point within a fragmented FRM system, given a certain type of fragmentation. On the basis of this table, for all relevant points and identified actor sets, the appropriate combination of types of bridging mechanisms can be determined.

On the basis of Table 2, both transfer and coordination mechanisms should in principle be present under all types of fragmentation. This can be explained by the fact that a lack of information or experience or a clash of policies can emerge, regardless of whether relevant actors operate within the same policy domain or pursue the same FRM strategy. Only when actors do in fact pursue the same FRM strategy – irrespective of whether they operate within the same policy domain – a cooperation mechanism should in principle be in place in order to deal with their mutual dependency in the pursuit of their shared strategy (type 2 and type 3 fragmentation). As there will be no evident mutual dependency between actors in the pursuit

Table 2: Types of bridging mechanisms to be present at relevant points within a fragmented FRM system given certain types of fragmentation

	Type 1	Type 2	Type 3	Type 4
Lack of information/ experience	Transfer	Transfer	Transfer	Transfer
One policy hinders another	Coordi- nation	Coordi- nation	Coordi- nation	Coordi- nation
Mutual dependency	N/A	Coopera- tion	Coopera- tion	N/A

³⁷ This former actor can be an existing actor (for instance an organ of a municipality), but also a newly established actor. Dutch Security Regions can, for instance, be considered newly (2010) established actors within the policy domain of emergency management.

of different FRM strategies, there is no direct need for cooperation mechanisms under such circumstances (type 1 and type 4 fragmentation). From the perspective of potential difficulties, type 2 and type 3 fragmentation can thus be considered as more 'complex' than the other two types, requiring a wider range of specific types of bridging mechanisms.

3.3 The quality of interconnectedness: are the identified bridging mechanisms effective themselves?

Apart from the degree of interconnectedness, its quality is also a key indicator for the effectiveness of FRM. So as to obtain an overall view of the quality of the interconnectedness within an FRM system, the effectiveness of all bridging mechanisms present within an FRM system should be evaluated separately. Apart from describing these mechanisms and especially their specific goals in more detail, such an evaluation should follow a pre-determined and preoperationalised set of indicators and/or benchmarks and – in addition to desk studies – may require stakeholder/expert involvement through interviews and focus group sessions.³⁸ Inspired by interdisciplinary research about the effectiveness of responsibilities for climate adaptation in vulnerable network sectors, suggested indicators for the effectiveness of bridging mechanisms are their explicitness/transparency, enforceability/compliance and legitimacy/support.³⁹ Given the inter-

³⁸ See eg D L Morgan 'Focus groups' (1996) 22(1) *Annual Review of Sociology* 129–52; V Wilson 'Research methods: focus groups' (2012) 7(1) *Evidence Based Library and Information Practice* 129–31; V Wilson 'Research methods: interviews' (2012) 7(2) *Evidence Based Library and Information Practice* 96–98; E S Säynäjoki, J Heinonen and S Junnila 'The power of urban planning on environmental sustainability: a focus group study in Finland' (2014) *Sustainability* 6622–43; and H A C Runhaar, C J Uittenbroek, H F M W van Rijswijk, H L P Mees, P P J Driessen and H K Gilissen 'Prepared for climate change? A method for the ex ante assessment of the comprehensiveness, transparency, legitimacy and expected effectiveness of responsibilities for climate adaptation' (2015) *Regional Environmental Change* 1, 8–9.

³⁹ See H A C Runhaar, H K Gilissen, C J Uittenbroek, H L P Mees and H F M W van Rijswijk *Publieke en/of private verantwoordelijkheden voor klimaatadaptatie: Een juridisch-bestuurlijke analyse en eerste beoordeling*, Copernicus Institute of Sustainable Development/Utrecht Centre for Water, Oceans and Sustainability Law (2014); H K Gilissen, C J Uittenbroek, H F M W van Rijswijk, H L P Mees, P P J Driessen and H A C Runhaar 'De klimaatbestendigheid van de vitale infrastructuur beoordeeld vanuit juridisch-bestuurlijk perspectief: Over de verwachte effectiviteit van de verdeling van verantwoordelijkheden voor de beheersing van klimaatrisico's in de elektriciteits- en de internetsector' (2015) 90(25) *Nederlands Juristenblad* 1640–48; Runhaar and others (n 38); and H K Gilissen, P P J Driessen, H L P Mees, H F M W van Rijswijk, H A C Runhaar, C J Uittenbroek and R Wörner 'The climate resilience of critical infrastructural network sectors: an interdisciplinary method for assessing the "expected effectiveness" of the division of responsibilities for the management of climate risks in the Dutch electricity and internet sectors', *Effectiveness in Environmental Law* 2016. See also W N Adger, N W Arnell and E L Tompkins 'Successful adaptation to climate change across scales' (2005) 53(6) *Global Environmental Change* 767–91; M van Rijswijk, W Salet 'Enabling the contextualization of legal rules in responsive strategies to climate change' (2012) 17(2) *Ecology and Society* 18–25; A van Buuren, P Driessen, G Teisman and M van Rijswijk 'Toward legitimate governance strategies for climate adaptation in the Netherlands: combining insights from a legal, planning and network perspective' (2014) 14(3) *Regional Environmental Change* 1021–33; Hegger and others (n 5); H Mees, J Dijk, D van Soest, P Driessen, M van Rijswijk and H Runhaar 'A method for the deliberate and deliberative selection of policy instrument mixes for climate change adaptation' (2014) 19(2) *Ecology and Society* 58–71; and M Petterson, K Ek, C Suykens, J C Beyers, S Priest, M Alexander, J Pardoe and M van Rijswijk *Best Practices and Design Principles for Resilient, Efficient and Legitimate Flood Risk Governance: Lessons from Cross-country Comparison* (Report no D5.2) STAR-FLOOD Consortium (2016).

disciplinary approach of this article, the suggested indicators are also of a 'mixed' nature, comprising legal and governance aspects.

In order to meet the first criterion (explicitness/transparency), the responsibilities relating to bridging mechanisms, as to their specific goals and application, should be formulated as clearly and in as much detail as possible, in order to provide an optimal degree of legal certainty. It does not matter whether this is done through legislation or guiding, explanatory or policy documents, as long as all responsibilities are knowable (who is responsible?) and clear (what does this responsibility imply?) to all relevant actors and other potentially interested parties. Moreover, bridging mechanisms especially established for specific FRM purposes can be considered more explicit than very generally formulated and applicable mechanisms aiming at, for instance, the coordination of an unspecified number of tasks.⁴⁰

Responsibilities should not only be knowable and clear, but should also be enforceable. This means that effective instruments should be in place to force relevant actors to comply with their (mutual) responsibilities. One could think of court procedures, mediation tracks or other dispute settlement constructions, but also of inter-administrative supervisory structures, penalty or liability systems, or even naming and shaming constructions. Regarding their formalised nature, statutory bridging mechanisms can be expected to be more enforceable than informal bridging mechanisms. This, however, is not to say that informal bridging mechanisms by definition are less effective than their statutory counterparts.⁴¹

The latter indicator requires the responsibilities resulting from bridging mechanisms to be legitimate in legal terms (democratically legitimate) and also to be conceived of as legitimate (or supported) by the relevant actors. This means that bridging mechanisms should have been developed under legitimate legal conditions (eg a proper (democratic) legislative process, taking into account all relevant interests), and that relevant actors and other potentially interested parties should properly have been involved and have had a chance actively to participate in the development process. Moreover, this indicator requires that the responsibilities resulting from bridging mechanisms are – from a more subjective perspective – considered reasonable and acceptable by those who are responsible and accountable.⁴²

40 See A W G J Buijze *The Principle of Transparency in EU Law* (dissertation Utrecht University 2013); Mees and others (n 39); Runhaar and others (n 38) 4, 8–10; Gilissen and others 'De klimaatbestendigheid van de vitale infrastructuur beoordeeld vanuit juridisch-bestuurlijk perspectief' (n 39) 1643–44, 1646–47; M van den Broek *Preventing Money Laundering: A Legal Study on the Effectiveness of Supervision in the European Union* (dissertation Utrecht University Eleven International Publishing 2015); and Gilissen and others 'The climate resilience of critical infrastructural network sectors' (n 39) 7–8.

41 See A B Blomberg, F C M A Michiels *Handhaven met effect* (VUGA 1997); J H Jans, R de Lange, S Prechal and R J G M Widdershoven *Europeanisation of Public Law* (Europa Law Publishing 2007); and A W G J Buijze 'Effectiviteit in het bestuursrecht' (2009) 8 *Nederlands Tijdschrift voor Bestuursrecht* 228–37.

42 See V Bekkers, A Edwards 'Legitimacy and democracy: a conceptual framework for assessing governance practices' in V Bekkers, G Dijkstra, A Edwards and M Fengler (eds) *Governance and the Democratic Deficit: Assessing the Democratic Legitimacy of Governance Practices* (Ashgate Publishing Ltd 2007) 35–60; Mees and others (n 39); Runhaar and others (n 38) 4, 8–9; and Gilissen and others 'De klimaatbestendigheid van de vitale infrastructuur beoordeeld vanuit juridisch-bestuurlijk perspectief' (n 39) 1644, 1647.

4 COUNTRY ANALYSES: EXAMPLES FROM EMPIRICAL RESEARCH

The above sections have provided theoretical – and admittedly rather abstract – insight into the concepts of fragmentation, bridging mechanisms and interconnectedness, as well as the relations between these concepts. In this section, empirical data are presented about the degree and specific types of fragmentation, as well as about different types of bridging mechanisms in the five selected countries' FRM systems. In so doing so, it is not intended to give a full view of the domestic situations, but rather further to substantiate and exemplify the concepts discussed above and to give an impression of the degree and types of fragmentation and the bridging mechanisms present in the countries selected. Thus, the intention is to stimulate further in-depth research into these (and other) countries' FRM systems. As stated in the introduction of this article, the data presented here result from empirical research conducted within the EU 'STAR-FLOOD' Project. These data, however, as results of the broader research project, were also in part at the base of the development of these concepts as such (see also section 1). In turn, these conceptual and empirical data also form the basis of the evaluation framework presented in section 5 below.

4.1 The degree and types of fragmentation in the countries selected

Unsurprisingly, all the domestic FRM systems selected show a certain degree of fragmentation, as in all countries distinct actors within distinct policy domains have distinct responsibilities and competences in the pursuit of distinct FRM strategies (see examples in Tables 3.1 to 3.5). Hence, different types of fragmentation are also present within the selected countries' FRM systems (see Tables 4.1 to 4.5). As an in-depth description of all domestic situations is not within the scope of this article,⁴³ a number of particularities, similarities and differences are discussed below. Although other policy domains are also relevant in relation to FRM, the focus here is on the domains of water management, spatial planning and emergency management.

First, focusing on the *degree* of fragmentation, there are striking differences as to the distinction between relevant policy domains in which actors bear responsibilities and competences for the pursuit of FRM strategies. This is important for determining the degree (and types) of fragmentation of a domestic FRM system. In France, for instance, five relevant policy domains are distinguished in which a specialised actor bears responsibilities for multiple strategies, resulting in multiple actors operating in different policy domains being partly responsible for the pursuit of the same strategy (see Table 3.3). In the UK, for the purposes of this article, three policy domains are distinguished, but responsibilities for the pursuit of their corresponding FRM strategies are divided between a large number of actors within those domains (see Table 3.1). In Poland, Belgium and the Netherlands, three policy domains are also distinguished in which one or a few

43 For more in-depth analyses, see Alexander and others (n 11); Kaufmann and others (n 11); Larrue and others (n 11); Matczak and others (n 11); Mees and others (n 11); and Matczak and others (n 13).

Table 3.1: Main actors in selected policy domains within the English FRM system (UK)

<i>Policy domain</i>	<i>Main actors</i>	<i>FRM strategy/strategies</i>
Spatial planning	<ul style="list-style-type: none"> • Department for Communities and Local Government (DCLG) • Local planning authorities • Planning applicant or developer 	Prevention
Flood defence/mitigation	<ul style="list-style-type: none"> • Lead Local Flood authorities (LLFA) • Environment Agency (EA) • Department for Environment, Food and Rural Affairs (Defra) • Regional Flood and Coastal Committees (RFCC) • Riparian owners • Highways Agency • Water companies • Internal drainage boards • A range of other (private) actors may be contracted under new partnership agreements 	Defence/mitigation
Emergency management	<ul style="list-style-type: none"> • Category 1 responders (emergency services, EA, and Local authorities (LAs)) • Category 2 responders (utility companies, telecommunications, transport operators, Health and Safety Executive, NHS Trust Development Authority) • Government departments involved in emergency response: Defra, DCLG, Civil Contingencies Secretariat (CCS) • Met Office • Flood Forecasting Centre • Voluntary sector 	Preparation and response

Table 3.2: Main actors in selected policy domains within the Belgian FRM system (Belgium)

<i>Policy domain</i>	<i>Main actor(s)</i>	<i>FRM strategy/strategies</i>
Water management	Water managers	Defence; prevention; mitigation
Spatial planning	Spatial planning authorities (at different administrative levels)	Prevention; mitigation
Emergency management	Emergency management authorities; emergency services; volunteers	Preparation and response

Table 3.3: Main actors in selected policy domains within the French FRM system (France)

<i>Policy domain</i>	<i>Main actor(s)</i>	<i>FRM strategy/strategies</i>
Natural risk management	Natural risk management authorities (State)	Defence; prevention; mitigation
Spatial planning	Spatial planning authorities	Prevention; mitigation
Emergency management	<ul style="list-style-type: none"> • Emergency management authorities • Emergency services 	Preparation and response
Water management	Water management authorities	Mitigation; defence
Water and flood management (emerging policy domain)	Municipalities	Defence; mitigation

Table 3.4: Main actors in selected policy domains within the Dutch FRM system (The Netherlands)

<i>Policy domain</i>	<i>Main actor(s)</i>	<i>FRM strategy/strategies</i>
Water system management	Water management authorities	Defence; mitigation; preparation and response
Spatial planning	Spatial planning authorities (at different administrative levels)	Prevention/mitigation
Emergency management	<ul style="list-style-type: none"> • Emergency management authorities • Emergency services • Utility providers • Volunteers 	Preparation and response

Table 3.5: Main actors in selected policy domains within the Polish FRM system (Poland)

<i>Policy domain</i>	<i>Main actor(s)</i>	<i>FRM strategy/strategies</i>
Water management	<ul style="list-style-type: none"> • Regional water management boards • Provincial authorities for drainage, irrigation and infrastructure 	Defence; preparation and response
Spatial planning	municipal spatial planning authorities	Prevention/mitigation
Crisis management	<ul style="list-style-type: none"> • Emergency management authorities (at different administrative levels) • State Fire brigades and other emergency services • Institute for Meteorology and Water Management 	Preparation and response

Table 4.1: Examples of different types of fragmentation within the FRM system in the UK

<i>Type of fragmentation</i>	<i>Actor sets/groups and strategies</i>
Type 1 (distinct domains; different strategies)	<ul style="list-style-type: none"> All actors within flood defence/mitigation and spatial planning domains (<i>defence/mitigation – prevention</i>)
Type 2 (same domain; same strategy)	<ul style="list-style-type: none"> All actors within spatial planning domain (<i>prevention</i>) All actors within Emergency management domain (. . . Category 1 and Category 2 responders) (<i>preparation and response</i>) All actors within flood defence/mitigation as they have responsibilities for both strategies (<i>defence/mitigation</i>)
Type 3 (distinct domains; same strategy)	<ul style="list-style-type: none"> Although community engagement (as part of the preparation and response strategy) is mainly performed within emergency management activities, a range of other methods are employed external to this and involve different actors from other policy domains (<i>preparation and response</i>)

Table 4.2: Examples of different types of fragmentation within the FRM system in Belgium

<i>Type of fragmentation</i>	<i>Actor sets/groups and strategies</i>
Type 1 (distinct domains; different strategies)	<ul style="list-style-type: none"> Water managers – spatial planners (<i>defence – mitigation/prevention</i>) Water managers – emergency managers (<i>defence – preparation and response</i>) Spatial planners – emergency managers (<i>mitigation/prevention – preparation and response</i>)
Type 2 (same domain; same strategy)	<ul style="list-style-type: none"> Actors at different administrative levels within spatial planning domain (<i>mitigation/prevention</i>) Emergency authorities – emergency services (<i>preparation and response</i>) Different actors within water management domain (<i>defence/prevention/mitigation</i>)

Table 4.3: Examples of different types of fragmentation within the FRM system in France

<i>Type of fragmentation</i>	<i>Actor sets/groups and strategies</i>
Type 1 (distinct domains; different strategies)	<ul style="list-style-type: none"> Natural risk management authorities – spatial planning authorities (<i>defence – prevention/mitigation</i>) Water management authorities – spatial planning authorities (<i>defence – prevention/mitigation</i>) Natural risk management authorities – emergency management authorities (<i>defence/prevention/mitigation – preparation and response</i>) Water management authorities – emergency management authorities (<i>defence/mitigation – preparation and response</i>) Emergency management authorities – spatial planning authorities (<i>preparation and response – prevention/mitigation</i>)
Type 2 (same domain; same strategy)	<ul style="list-style-type: none"> Different actors within civil security domain (<i>preparation and response</i>)
Type 3 (distinct domains; same strategy)	<ul style="list-style-type: none"> Natural risk management authorities – spatial planning authorities (<i>prevention</i>) Natural risk management authorities – spatial planning authorities (<i>mitigation</i>) Natural risk management authorities – water management authorities (<i>defence</i>) Natural risk management authorities – water management authorities (<i>mitigation</i>) Water management authorities – spatial planning authorities (<i>mitigation</i>)

Table 4.4: Examples of different types of fragmentation within the FRM system in the Netherlands

<i>Type of fragmentation</i>	<i>Actor sets/groups and strategies</i>
Type 1 (distinct domains; different strategies)	<ul style="list-style-type: none"> Water management authorities – spatial planning authorities (<i>defence – mitigation/prevention</i>) Spatial planning authorities – emergency management authorities (<i>mitigation/prevention – preparation and response</i>) Water management authorities – emergency management authorities (<i>defence – preparation and response</i>; also see below)
Type 2 (same domain; same strategy)	<ul style="list-style-type: none"> Actors at different administrative levels within spatial planning domain (<i>mitigation/prevention</i>) All relevant actors within EM domain (<i>preparation and response</i>)
Type 3 (distinct domains; same strategy)	<ul style="list-style-type: none"> Emergency management authorities – water management authorities (as far as <i>preparation and response</i> is concerned)

Table 4.5: Examples of different types of fragmentation within the FRM system in Poland

Type of fragmentation	Actor sets/groups and strategies
Type 1 (distinct domains; different strategies)	<ul style="list-style-type: none"> Regional water management boards – municipal spatial planning authorities (<i>defence – mitigation/prevention</i>) Municipal spatial planning authorities – emergency management authorities (<i>mitigation/prevention – preparation and response</i>)
Type 2 (same domain; same strategy)	<ul style="list-style-type: none"> Relevant actors within crisis management domain (<i>preparation and response</i>)
Type 3 (distinct domains; same strategy)	<ul style="list-style-type: none"> Provincial authorities for drainage, Irrigation and Infrastructure – emergency management authorities (<i>preparation and response</i>)

actors bear responsibilities for a single or a limited number of FRM strategies (see Tables 3.2, 3.4 and 3.5). As the number of actors for each policy domain in these countries is limited and the responsibilities for certain strategies are rather straightforwardly divided for each policy domain, the degree of fragmentation in the UK and France is considerably higher than in the other countries.

Focusing on *types* of fragmentation, an initial finding is that all countries' emergency management arrangements can be considered a form of type 2 fragmentation (see Tables 4.1 to 4.5). Although these arrangements vary substantively (mainly as to the division of responsibilities between distinct actors or actor groups), they have in common that they all constitute a distinct policy domain in which distinct (groups of) actors pursue the same FRM strategy (preparation and response). In the UK, in this respect, a statutory division is made between coordinating government departments, category 1 responders (mainly emergency services), category 2 responders (eg utility services) and the voluntary sector. In the other countries, a distinction is made between specialised emergency management authorities (at different levels and of different compositions) and emergency services, and in some cases utility services and the voluntary sector.⁴⁴ In the Netherlands, Poland and the UK, actors within other policy domains also have certain responsibilities in the pursuit of the preparation and response strategy.⁴⁵ This is, however, to be considered a form of type 3 fragmentation (see Tables 4.1, 4.4 and 4.5).

In addition, other types of fragmentation are present within the FRM systems of the countries selected. However, in none of the countries can type 4 fragmentation be discerned (see Tables 4.1 to 4.5). This type of fragmentation, therefore, seems to be rare. In the Netherlands, however, a form of type 4 fragmentation is emerging, as the intended legal integration of the policy domains of water system management and spatial planning into the single policy domain of 'environmental planning' will lead to a situation in which two distinct actors (spatial planning authorities (SPAs) and water management authorities (WMAs)) will pursue different strategies (prevention/mitigation and defence, respectively) whilst operating within the same policy domain.⁴⁶ Forms of type 1

fragmentation are the most common and eminent in Poland, Belgium and the Netherlands, as in these countries a rather strict distinction is made between policy domains, corresponding strategies and (single) actors who bear responsibilities in this respect (see Tables 4.2, 4.4 and 4.5).⁴⁷ Owing to the specific degrees of fragmentation in the UK and France (see above), in these countries type 2 and type 3 fragmentation are more common, respectively (see Tables 4.1 and 4.3). The selected policy domains in the UK, after all, show a wide range of actors that pursue the same strategy, whilst in France, a wide range of actors operating in different policy domains pursue the same strategy with different means.

Finally, two particular forms of fragmentation deserve to be mentioned here. In Belgium, the Netherlands and Poland, responsibilities within certain policy domains (spatial planning, emergency management) are divided between a number of actors at different administrative levels. In most cases there are also hierarchical relations between these actors.⁴⁸ This form of 'vertical' fragmentation can be considered a specific form of type 2 fragmentation (see Tables 4.2 and 4.4). Another particular form of type 2 fragmentation – which, for the sake of clarity, has not been included in the tables below, but is nonetheless worth mentioning – can be referred to as 'areal' (regional) fragmentation. This form of fragmentation emerges where the same type of actors (local or regional authorities) have the same type of responsibilities and competences for governing distinct (neighbouring) areas. This form of fragmentation, can be seen as resulting from decentralisation and is extremely common across the countries selected and other decentralised countries.

47 Flemish water management, however, includes several water managers, respectively the Department of Mobility and Public Works for navigable watercourses, the Flemish Environment Agency for non-navigable watercourses 1st category, the provinces for non-navigable watercourses 2nd category and the municipalities for non-navigable watercourses 3rd category (although since 2014, most 3rd category watercourses are under the auspices of the provinces). At locations where a polder or wateringue is still active, the management of 2nd and 3rd category non-navigable watercourses is under their charge. For the sake of clarity, these have been classified under the policy domain water management. Coordination between these water managers happens through the Coordination Committee on Integrated Water Policy (Decree Integral Water Policy 2003) on the basis of the 2003 Decree Integral Water Policy, which strives for integrated water management, and thus pertains to management of water resources, spatial planning, and so forth.

48 See eg D Korse *Ruimtelijke ordening op niveau: Een juridisch onderzoek naar provinciale en nationale instructieregels op grond van hoofdstuk 4 van de Wro* (dissertation Utrecht University Instituut voor Bouwrecht 2014).

44 See eg E T Brainich, I Helsloot 'Wet veiligheidsregio's' in E R Muller, E T Brainich and L J J Rogier (eds) *Tekst en Commentaar Openbare Orde en Veiligheid* (Kluwer 2014) 635–742; and E R Muller 'Crisis en recht: Naar een integrale Crisisbeheersingswet?' in E R Muller, T Hartlief, B F Keulen and H Kummeling *Crisis, rampen en recht* (Preadviezen Nederlandse Juristen-Vereeniging 2014–1, Kluwer 2014) 1–64.

45 See eg H J M Havekes, P J de Putter *Wegwijzer Waterwet 2014: Een Praktische Handleiding* (Kluwer 2014) 161–68.

46 For closer reading see eg Nijenhuis (n 36); and Nijmeijer (n 36).

4.2 Bridging mechanisms in the selected countries

Having presented examples of the degrees and types of fragmentation in the countries selected in the previous section, this section focuses on types of bridging mechanisms present in those countries. It should be mentioned here that it is impossible, within the scope of one article, to give a full view and an in-depth description of all bridging mechanisms present, let alone thoroughly to evaluate the degree and quality of the interconnectedness within the selected countries' FRM systems. Instead, a number of examples are presented below (Tables 5.1 to 5.5). For further evaluations of the interconnectedness within domestic FRM systems, the evaluation framework presented in section 5 is recommended, as specifically developed for this purpose.

In all countries, the relations between actors within the spatial planning domain and the domain of flood/water management⁴⁹ is considered a form of type 1 fragmentation, as different actors or actor groups operating in distinct policy domains pursue different strategies. In order to resolve potential difficulties resulting therefrom, all countries have implemented specific transfer mechanisms. Moreover, most countries – except for Poland and France – have also implemented coordination mechanisms (see Tables 5.1 to 5.5). It is striking that all transfer mechanisms, although highly different in nature, appear as advisory or consulting structures on the basis of which actors specialised in FRM have advisory or consulting roles in spatial decision-making. Well known examples are the Dutch⁵⁰ and Belgian⁵¹ variants of the 'water test', but similar statutory structures are present in the UK,⁵² France⁵³ and Poland.⁵⁴ Coordination mechanisms vary from general statutory obligations to align spatial and water policies (the Netherlands),⁵⁵ to the establishment of specialised coordination committees (Belgium)⁵⁶ and the continued coordinating effects of the advisory/consulting mechanisms mentioned (the UK and Belgium).⁵⁷

A form of type 2 fragmentation that is evident in all of the countries selected is the relations between relevant actors within the emergency management policy domain. Also, in this respect, the distinct countries have developed very different arrangements,⁵⁸ although the degree of interconnectedness at first glance can be considered optimal, as all countries have implemented specific transfer and coordination, as well as cooperation mechanisms (see Table 5.1 to 5.5). Transfer mechanisms range from statutory duties to the sharing of information (the UK),

to information exchange structures in the framework of established committees or crisis centres (Belgium, Poland) and different types of consultation or participation structures (France, the Netherlands).

Coordination mechanisms are also varied, as coordination in some countries is promoted through specific (resilience) fora, committees or crisis centres (the UK, Belgium), whereas in other countries this is mainly done through alignment of strategic and operational policies (France, the Netherlands). In addition, cooperation structures vary from statutory duties to cooperate (the UK), to (ad hoc or formalised) cooperation in the framework of specific institutions (Poland, Belgium), periodical exercises (France) and/or semi-formal instruments, such as covenants (the Netherlands).

A specific form of type 3 fragmentation is emerging in the UK, the Netherlands and Poland, as in these countries distinct actors operating within distinct policy domains pursue the preparation and response strategy using different means (see Tables 5.1, 5.4 and 5.5). Only in the Netherlands do transfer and coordination mechanisms have a firm legal basis in this respect. Information transfer is promoted through consultation and the formal role of water management authorities in the security regions' board meetings. Coordination is fostered through the compulsory alignment of strategic and operational emergency plans of relevant water management authorities and emergency management authorities. Cooperation, in the Netherlands, largely takes place on an informal basis (eg cooperation in the organisation of periodical exercises), although formalisation has been considered in the past.⁵⁹ In the UK, although the emergency management as such is highly formalised, information transfer and coordination mechanisms between actors within the strict emergency management domain and other relevant actors operating in other domains have not been formalised and their activities are mostly coordinated on a more informal basis.

5 EVALUATION FRAMEWORK: A SEVEN-STEP METHOD FOR FUTURE RESEARCH

Although the data presented above give an impression of the degree of fragmentation and the bridging mechanisms established in order to facilitate interconnectedness within the selected countries, on the basis thereof no firm conclusions can yet be drawn about the interconnectedness within these countries' FRM systems. A full overview and an analysis of the quality of interconnectedness within these countries' FRM systems require comprehensive, structured and more in-depth system evaluations. Since such a framework has not yet been developed, this section presents an interdisciplinary methodological framework for the evaluation of the interconnectedness within domestic FRM systems through seven successive steps. Rooted in the conceptual and empirical analyses set out above, this methodological framework is meant as a guideline for further research.⁶⁰

49 These policy domains are referred to in differing forms in the countries selected.

50 See Groothuijse and Van Rijswijk (n 15); Groothuijse (n 15); Van Rijswijk and Havekes (n 4); Gilissen, Kevelam and Van Rijswijk (n 15); OECD (n 14); Van Rijswijk (n 15); and Kaufmann and others (n 11).

51 See Denys and Toury (n 15); Ameloot (n 15); Carette and De Smedt (n 15); and Mees and others (n 11).

52 See Alexander and others (n 11).

53 See Larrue and others (n 11).

54 See Matczak and others (n 11).

55 See Havekes and De Putter (n 45).

56 See P de Smedt 'Water anders ordenen? De impact van het decreet van 18 juli 2003 betreffende het integraal waterbeleid op het beleidsdomein van de ruimtelijke ordening' (2003) *TROS* 321–38; and Carette and De Smedt (n 15).

57 See Alexander and others (n 11); and Mees and others (n 11).

58 See Gilissen and others 'A framework for evaluating the effectiveness of flood emergency management systems in Europe' (n 9).

59 See Havekes and De Putter (n 45) 164.

60 Inspiration for this framework was drawn from Runhaar and others (n 39); Runhaar and others (n 38); Gilissen and others 'De klimaatbestendigheid van de vitale infrastructuur beoordeeld vanuit juridisch-bestuurlijk perspectief' (n 39); and Gilissen and others 'The climate resilience of critical infrastructural network sectors' (n 39).

Table 5.1: Examples of bridging mechanisms addressing fragmentation within the UK FRM system (UK)

	<i>Type 1: Prevention and defence/mitigation</i>	<i>Type 2: Emergency management (preparation and response)</i>	<i>Type 3: Preparation and response (more broadly)</i>
Transfer	The EA and LLFAs are statutory consultees for spatial planning decision-making for large-scale developments; flood risk standing advice is also provided by the EA for small-scale developments (Town and Country Planning (Development Management Procedure) (England) Order 2010)	All Category 1 and 2 responders have statutory duties to share information (and cooperate) (Civil Contingencies Act (Contingency Planning) Regulations 2005)	Informal information exchange between relevant actors in order to coordinate activities
Coordination	The national planning policy framework sets out mechanisms to prevent inappropriate development in at-risk areas (i.e. sequential and Exception tests)	Category 1 responders are required to form Local resilience forums (LRFs), integrating/coordinating policies, and must attend regular meetings to facilitate multi-agency, joined-up working, with the support of Category 2 responders (Civil Contingencies Act (Contingency Planning) Regulations 2005)	Although community engagement activities can be performed within the FRM policy domain or civil contingencies policy domain, these activities are often coordinated, or at least delivered in a way that is mutually-beneficial
Cooperation	N/A	All Category 1 and 2 responders have statutory duties to cooperate (and share information) (Civil Contingencies Act (Contingency Planning) Regulations 2005)	No clear arrangement

Table 5.2: Examples of bridging mechanisms addressing fragmentation within the Belgian FRM system (Belgium)

	<i>Type 1: defence and prevention/mitigation</i>	<i>Type 2: Emergency management (preparation and response)</i>
Transfer	Water test (statutory advisory mechanism) (Decree Integrated Water Policy 2003)	Municipal/provincial level: Information transfer between relevant actors within 'safety cells' (Royal Decree of 16 February 2006) Federal level: Coordination and Crisis Centre of the Government (Royal Decree of 18 April 1988)
Coordination	Coordination through water test and the Coordination Committee on Integrated Water Policy (CIW) (Decree Integrated Water Policy 2003)	Municipal/provincial level: Coordination through 'safety cells' and coordination committees (Royal Decree of 16 February 2006) Federal level: coordination by the Coordination and Crisis Centre of the Government (Royal Decree of 18 April 1988)
Cooperation	N/A	Municipal/provincial level: cooperation through 'safety cells' (Royal Decree of 16 February 2006) Federal level: cooperation through the Coordination and Crisis Centre of the Government (Royal Decree of 18 April 1988)

Table 5.3: Examples of bridging mechanisms addressing fragmentation within the French FRM system (France)

	<i>Type 1: Defence and prevention/mitigation</i>	<i>Type 2: Emergency management (preparation and response)</i>	<i>Type 3: Defence/mitigation</i>
Transfer	Formal consultation of SPAs during decision processes led by the NRMAs; informal transfer of information (eg dialogues between authorities)	Formal role of state authorities in security regional board meetings, and consultation in strategic emergency planning	No clear arrangement
Coordination	No clear arrangement	Compulsory alignment of strategic and operational emergency planning	Compulsory alignment of water management planning, spatial planning and water infrastructures development; river contracts (coordinated non-binding multi-actor water management programmes)
Cooperation	N/A	Exercises and simulations involving a plurality of actors	Cooperation through water boards

Table 5.4: Examples of bridging mechanisms addressing fragmentation within the Dutch FRM system (The Netherlands)

	<i>Type 1: Defence and prevention/mitigation</i>	<i>Type 2: Emergency management (preparation and response)</i>	<i>Type 3: Preparation and response (focusing on relations between WMAs and EMAs)</i>
Transfer	Water test (statutory advisory mechanism) (Spatial Planning Decree 2008)	Participation of relevant actors in security regions' board meetings and specific communication channels during emergency situations (Security Regions Act 2010)	Formal role of WMAs in security regions' board meetings, and consultation in strategic emergency planning (Security Regions Act 2010)
Coordination	General coordination duty between WMA and SPA policies (Water Act 2009)	Coordination through generic operational emergency planning and coordinating teams at different operational and administrative levels (Security Regions Act 2010)	Compulsory alignment of strategic and operational emergency planning (Security Regions Act 2010/Water Act 2009)
Cooperation	N/A	Covenants between EMAs and utility providers (informal, but 'good practice')	Largely on informal basis (eg exercising), although formalisation was considered

Table 5.5: Examples of bridging mechanisms addressing fragmentation within the Polish FRM system (Poland)

	<i>Type 1: Defence and mitigation/prevention</i>	<i>Type 2: Crisis management (preparation and response)</i>	<i>Type 3: Preparation and response (focusing on relations between provincial authorities and EMAs)</i>
Transfer	Formal consultation of regional water management boards in municipal (local) spatial planning (Water Act 2001 and Spatial Planning and Development Act 2003)	Crisis management centres and teams (municipal, county and provincial levels)	Crisis management centres teams (municipal, county and provincial levels)
Coordination	No clear arrangement	IT system for protection against extraordinary hazards	Coordination through crisis management centres (at municipal, county and provincial levels)
Cooperation	N/A	National rescue and firefighting system	N/A

A pragmatic, flexible and broadly applicable research tool, this framework could prove useful for both academic and practical purposes (eg concept development, system evaluations and system (re)development). This novel method comprises seven successive steps, arranged into three research phases: (1) the preparatory and analytical phase; (2) the evaluation phase; and (3) the phase of reflection and drawing conclusions. In Tables 6.1 to 6.3, the successive steps within these phases are schematically presented and briefly exemplified. Specific research techniques are also suggested where relevant.

5.1 Phase 1: Preparation and analysis

The preparatory and analytical phase aims at 'setting the scene' and analysing and arranging all relevant information in order to perform the evaluation in a structured manner.⁶¹ This phase comprises three steps. It mainly requires in-depth system analysis, including literature review, analysis of legislation, explanatory memoranda and policy documents, and perhaps stakeholder/expert

involvement through interviews and focus group sessions.⁶²

5.2 Phase 2: Evaluation

The evaluation phase forms the core of this evaluation framework. It comprises two steps, mainly building upon the information gathered and arranged during the previous phase/steps. Apart from in-depth system and situation analysis, this phase requires the selection and operationalisation of evaluation criteria for assessing the effectiveness of specific arrangements, in this case indicators and/or benchmarks for evaluating the effectiveness of bridging mechanisms. Apart from the suggestions for evaluation criteria presented in section 3.3, further developing and enriching the set of evaluation criteria may require additional studies into (methodological) literature.⁶³

61 If the evaluation, moreover, is part of a comparative research project, a structured framework could optimise comparative potential. See R Azarian 'Potentials and limitations of comparative method in social science' (2011) 1(4) *International Journal of Humanities and Social Science* 113–25.

62 See eg Morgan (n 38); Wilson 'Research methods: focus groups' (n 38); Wilson 'Research methods: interviews' (n 38); Säynäjoki and others (n 38); and Runhaar and others (n 38) 8–9.

63 See eg Adger and others (n 39); Van Rijswijk and Salet (n 39); Van Buuren and others (n 39); Hegger and others (n 5); Mees and others (n 39); and Runhaar and others (n 38) 4.

Table 6.1: The preparatory and analytical phase

<i>Successive steps</i>	<i>Exemplification</i>	<i>Suggested research techniques</i>
Step 1: Description of the selected FRM system	<ul style="list-style-type: none"> Describe the selected FRM system, focusing on its characteristics, its implemented strategies, the relations between strategies, the policy domains, and the relevant actors, including their responsibilities and competences 	In-depth system analysis through: <ul style="list-style-type: none"> Literature review Analysis of legislation, explanatory memoranda, and policy documents Interviews/focus groups
Step 2: Determination of the degree of fragmentation	<ul style="list-style-type: none"> Schematically arrange the information from step 1 Determine (the amount of) actor sets (for examples, see Tables 3.1 to 3.5) and the degree of fragmentation 	
Step 3: Determination of types of fragmentation	<ul style="list-style-type: none"> Determine the type of fragmentation for every identified actor set on the basis of Figure 2 Schematically present the findings (for examples, see Tables 3.1 to 3.5) 	

Table 6.2: The evaluation phase

<i>Successive steps</i>	<i>Exemplification</i>	<i>Suggested research techniques</i>
Step 4: Identification of bridging mechanisms and 'gaps'	<ul style="list-style-type: none"> Determine the presence and types of bridging mechanisms for every actor set (as identified in steps 2 and 3), using Table 2 as a 'searching tool' Identify 'gaps' (ie does the situation meet the 'ideal-typical' situation depicted in Table 2?) Determine the degree of interconnectedness (ie to which extent are all actor sets interconnected through specific bridging mechanisms?) Describe the identified bridging mechanisms, focusing on their goals and (legal) characteristics 	In-depth system and situation analysis through: <ul style="list-style-type: none"> Literature review Analysis of legislation, explanatory memoranda, and policy documents Case studies Interviews/focus groups
Step 5: Evaluation and explanation of the results	<ul style="list-style-type: none"> Evaluate the effectiveness of the identified bridging mechanisms, at least following the criteria of explicitness, enforceability, and legitimacy (section 3.3) Explain the 'gaps' identified in step 4 Determine the quality of interconnectedness (ie to which extent are the identified bridging mechanisms effective themselves?) 	Further substantiation of finding through: <ul style="list-style-type: none"> Additional desk research Additional case studies Additional interviews/focus groups Refining the method through, for instance, introducing new indicators or specific benchmarks per indicator

Table 6.3: The concluding phase

<i>Successive steps</i>	<i>Exemplification</i>	<i>Suggested research techniques</i>
Step 6: Conclusions and recommendations	Draw conclusions about the effectiveness of FRM through the lens of interconnectedness <ul style="list-style-type: none"> Give recommendations (eg should at some point(s) in the system specific types of bridging mechanisms be implemented; or could the effectiveness of specific bridging mechanisms be improved?) Could identified 'good practices' be transferred to other systems? 	
Step 7: Reflection/refinement of the method	<ul style="list-style-type: none"> Reflect upon the practical application of the method (eg what went wrong; what was unclear; where did we get stuck; how can this be solved?) Reflect upon unexpected outcomes (eg a new type of bridging mechanism appeared) Improve the method based on the findings above 	

5.3 Phase 3: Conclusions, recommendations and reflection

The concluding phase comprises two steps. Apart from drawing conclusions about the degree and quality of the interconnectedness within (and, thus the effectiveness of) an FRM system and, if necessary, formulating recommendations for improvement, the applied method should also

be reflected upon itself for refining purposes. In case of cross-country comparisons, the transferability of identified 'good practices' can be assessed. It should not be forgotten, however, that bridging mechanisms or practices proving effective in one country are not necessarily as effective in another country with a different cultural, political, institutional or normative setting.

6 CONCLUSIONS

Diversification of FRM strategies is assumed to enhance societal resilience to flooding and, thus, the effectiveness of FRM. In this article, this assumption is nuanced. Acknowledging that diversification is indeed desirable, this article focuses on fragmentation of domestic FRM systems as one of its inevitable side-effects, which can potentially be detrimental to the effectiveness of FRM. This article claims, therefore, that resolving the difficulties relating to fragmentation through increasing the interconnectedness between relevant actors within fragmented domestic FRM systems is yet another condition for FRM to be effective. The instruments suited for this purpose are metaphorically referred to as bridging mechanisms. From the perspective of specific difficulties relating to fragmentation, three types of bridging mechanisms can be discerned, namely transfer mechanisms, coordination mechanisms and cooperation mechanisms.

On the basis of the identification of both degrees and types of fragmentation and their relating difficulties, specific points within FRM systems can be identified on which specific types of bridging mechanisms are needed. Having the appropriate types of bridging mechanisms implemented on the relevant points within an FRM system leads to an optimal degree of interconnectedness. In addition, the quality of interconnectedness is also key in order to contribute optimally to the effectiveness of FRM as such and, thus, enhance societal resilience to flooding. All bridging mechanisms within an FRM system should, in other words, be effective themselves as well. The effectiveness of bridging mechanisms can be determined following a mixed set of legal and extra-legal indicators, such as transparency, enforceability and legitimacy.

Building upon empirical research conducted within the framework of the EU 'STAR-FLOOD' Project, this article shows that – despite a number of similarities – both the degrees and types of fragmentation within the selected countries' FRM systems differ. Compared to Belgium, the Netherlands and Poland, the overall degree of fragmentation can be considered as high in the UK and France. In the former countries a limited number of policy domains are rather straightforwardly distinguished in which one or a few actors bear responsibilities for the pursuit of single or a limited number of FRM strategies. In the latter, such responsibilities for each policy domain are divided between a large number of actors (the UK), or multiple actors operating in different policy domains are partly responsible for the pursuit of the same strategy (France). This leads to the conclusion that there are more points within the English and French FRM systems that need bridging mechanisms than there are in the other countries.

Although three out of four types of fragmentation are present within all the selected countries' FRM systems, the overall differences in degrees of fragmentation also result in differences regarding the dominance of a specific type of fragmentation in each country. This article shows that

in the UK and France more 'complex' types of fragmentation (type 2 and type 3, respectively) are dominant, whereas in the other countries a 'simple' type of fragmentation (type 1) is more common. As a striking similarity, all countries' emergency management arrangements, however, can be considered more complex through the lens of fragmentation (type 2). Although this does not say much about the effectiveness of FRM in the respective countries, it should be noted that at the points where more complex types of fragmentation are present, a wider range of bridging mechanisms is also needed. Whereas, in terms of this article, in simple situations transfer and coordination mechanisms suffice, in more complex situations there is an additional need for cooperation mechanisms.

An investigation of a selection of types of fragmentation present in the selected countries shows that these countries have bridging mechanisms in place at (most) relevant points within their FRM systems. In general, in complex situations of fragmentation, these countries have indeed implemented specific cooperation mechanisms in addition to transfer and coordination mechanisms. Unsurprisingly, all specific bridging mechanisms differ greatly as to their nature and degree of formality across the countries selected. Nonetheless, there are similarities, for instance within the field of spatial planning, where all countries have implemented some formalised form of advisory or consulting mechanisms similar to the Dutch and Flemish 'water test'. Although some blank and unclear spots remain, the overall impression is that the degree of interconnectedness within the selected countries – at least regarding the investigated selection of situations of fragmentation – can be considered adequate, if not optimal.

Despite the positive tenor of the above, it is still too soon to conclude that all difficulties relating to fragmentation are properly taken care of, and that the selected countries' FRM systems can therefore be considered to be effective. This is something that just cannot be known at this stage, simply because there is too little information about the effectiveness of all bridging mechanisms in place, and about the quality of the interconnectedness. In order to draw such conclusions, the effectiveness of every single bridging mechanisms should be analysed and the results thereof should be reflected upon.

Here lies one of the major challenges for future FRM research. Rooted in its conceptual contemplations and aiming to facilitate such future research, this article therefore outlines a novel interdisciplinary methodological framework for evaluating the interconnectedness within domestic FRM systems. Given its cross-border comparative potential, the societal issues relating to FRM at stake and the overwhelming amount of work to be done, diversification, fragmentation, interconnectedness and the evaluation framework presented here could surely form the basis of a follow-up interdisciplinary research project. This is an open invitation; there still are many troubled waters to be bridged.