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DRIVERS AND BARRIERS TO MULTI-LAYERED FLOOD RISK MANAGEMENT: A COMPARATIVE STUDY OF DUTCH AND US PRACTICE

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ABSTRACT: After decades of primary focus on protection, the 2009 Dutch National Water Plan introduced Multi-Layered Safety (MLS) as national policy that also integrates spatial planning and emergency management into flood risk management. Around the same time, a number of regions in the US started exploring “multiple lines of defense” and implementing non-structural flood risk management programs. It proves to be difficult, however, to implement MLS in practice and to (optimally) balance investments across all three safety layers.

The purpose of this paper is to identify and compare drivers and barriers to the implementation of MLS in Dutch and US practice. In total, six case studies have been analysed and compared: three in the Netherlands (Kampen, Dordrecht and Almere) and three in the US (Valmeyer, Stockton and Natomas). The case study analysis focused on the participative process and development of the local strategy for flood risk management, the role of each safety layer within the strategy, and the rationale behind the strategy. In the analysis, specific attention was given to geographical, social and political contexts.

Drivers for implementing prevention measures (layer 2) were mostly tied to environmental regulations, social values and aesthetics. In Kampen and Almere, the region wanted to preserve the aesthetic and environmental quality that they felt would have been destroyed by simply building a large dike. In Natomas, the environmental stipulations of the Endangered Species Act actually required that the communities protect land for habitat values by purchasing conservation easements that would ensure land would be permanently in nature.

Investments in preparedness (layer 3) were influenced by geographical and physical factors. In Almere and Natomas, the presence of deep and densely populated polders demanded sufficient evacuation routes. Regulatory factors drove preparedness measures in both the Netherlands and the US.

Key Words: Flood Risk Management; Decision Making; Multi Layered Safety; Contextual Factors

1. INTRODUCTION

In 1993 and 1995, the Netherlands evacuated nearly 200.000 people for fear of a dike breach during high waters. This and the devastation witnessed along the US Gulf Coast left by Hurricane Katrina in 2005, reminded Dutch policy makers that even very high dikes do not completely rule out the risk of flooding, and that the consequences of a flood can be catastrophical (Deltacommissie, 2008). After decades of focus on structural measures to reduce the probability of flooding, the ambition in the Netherlands is now to also address the potential consequences, by integrating spatial planning and crisis management into flood risk management (FRM). However, the actual implementation in these domains seems to be lagging. This is similar in the US, where the great majority of decisions still favor structural measures—even though the US Army Corps of Engineers was required to consider non-structural flood control measures as early as 1974.

This article analyses local strategic choices and investment decisions concerning FRM, with the objective to gain better insight into the drivers and barriers for local policymakers and practitioners to choose for either preventative, protecting or preparing measures or for a combination of these.

2. THEORETICAL FRAMEWORK

The latest Dutch National Water Plan (2009) introduced the multi-layered safety (MLS) concept to integrate spatial planning and crisis management into flood risk management. The concept of MLS is based on the acknowledgement that flood risk can best be mitigated by a balanced combination of 'hard' preventative measures and 'softer' measures in policy and planning. MLS aims to reduce both the probability and the consequences of a flood through the use and integration of three layers of safety—prevention, protection and preparedness (figure 1).

Figure 1: The concept of Multi Layered Safety

Safety layer 1: *Prevention.* Preventative measures, or structural measures, to reduce the probability of flooding through dikes, seawalls, dams, etc.

Safety layer 2: *Protection.* Protective measures, or non-structural, emphasize sustainable spatial planning to reduce the consequences of flooding (or the residual risk mentioned above).

Safety layer 3: *Preparedness and Disaster Management.* Also called emergency response and disaster assistance, these measures also reduce the consequences of flood by minimizing loss of life and disruption, and expediting recovery after a flood.

Source: www.stowa.nl

The Dutch MLS approach is not necessarily unique; it follows a similar framework set in the 2007 European Union Floods Directive (2007/60/EC). And, around the same time, a number of regions in the US began more frequent discussions of "multiple lines of defense" and implementing non-structural FRM programs (Lopez, John A., 2006). Though, obviously, flood risk mitigation activities in safety, spatial planning, and emergency response existed before, the innovation coming from these new ways of thinking, and the premise for their success, is that the separate 'layers' or 'lines' are considered in relation to each other, combined into a holistic, well-balanced strategy.

The translation into implementation of the MLS approach raises practical issues; like how to best balance the investments across the three layers and how to decide on selecting a measure from one layer over a measure from another. Recent research in the Netherlands has explored the optimal balance of investments in one safety layer over another based on the risk (Tsimopoulou et al, 2014 and Hoss et al, 2013), but investment decisions are rarely based solely on risk. In practice, a variety of contextual factors may drive FRM decision making, sometimes enabling or hindering the successful reduction of flood risk by "favoring" certain safety layers (or measures) over others. These contextual factors could, in some cases, even be decisive for the successful/unsuccessful implementation of MLS related strategies.

In the field of policy administration it is widely recognized that 'context' influences public management and the decisions taken. In this use, the word context can be defined as "resource conditions and social and political settings that might present opportunities, create implementation hurdles, and affect policy

performance" (Honadle, 1999). There are no standard references however, on how to incorporate context or variables of contexts in policy evaluations or research (Proeller, 2013). Guy Peters (2013) discusses public management being influenced by: (1) Politics; much of what happens in public administration is shaped by the prevailing political system and the 'authorative allocation of values for a society'. (2) Law; public policy makers and administrators will always operate within a legal context, and their parameters of available actions will be shaped by law. (3) Economics and the Market; public administration and the market know a complex pattern of interactions. Although influenceable, the contemporary emphasis on 'the market' puts public policy makers in the position of having to respond. And (4) Society; the continuing development of "governance" approaches may have, similarly, increased the linkages between social actors and the public sector. These categories return in different forms throughout public policy literature (….) and provide an initial understanding about which factors affect strategic choices and investment decisions in FRM. The level of definition of these categories is quite high and abstract; a more practical take on the context of FRM policy design and implementation can be found through case studies dealing with FRM related topics. Several studies on climate change adaptation (Measham cs, 2011; Amundsen cs, 2010) have shown that on a local level, 'risk information', 'institutions' and 'resources' are essential elements to hinder or enable successful implementation of balanced strategies. 'Competing priorities' and 'established planning processes' are practical hindrances, specifically mentioned to be determining factors in decision making on the local level.

These practical observations do match quite well with the abstract categories mentioned before; except for the environmental perspective of risk information and the resources that were indeed already mentioned in the definition of 'context' and cannot be excluded. Using a straightforward, simple contraction of the observations above, contextual factors can be included in this research using three main categories: Geographic (including demographics etc.), Institutional (including laws etc.), Political (including financial considerations etc.).

3. METHOD AND DATA COLLECTION

In order to understand, analyze and compare the drivers for decision making in MLS (or FRM), data was collected following a three-part approach: 1) a desktop study and literature review, and workshop attendance, 2) expert interviews and 3) case studies.

Examining of existing literature to understand the current state of flood risk management practice in the context of each safety layer. Specifically, scientific peer-reviewed publications and reviewed official government reports, existing legislation, and government regulations were reviewed. Because little documentation exists on the drivers for flood risk management decision making, information from newspaper articles was extracted as well. These efforts formed the basis for the major inquiry and case study selection. On four occasions, workshops with practitioners and policy makers that addressed the issue of developing flood mitigation strategies were attended.

Twenty-one experts were interviewed to elicit the major drivers and rationale behind flood risk management decision making in the context of MLS. Interviews were largely open ended and influenced by the experts' own personal experiences. Interviewees were from both Rijkswaterstaat (RWS) and the US Army Corps of Engineers (USACE), from state, provincial and regional agencies, water boards, emergency responders and safety regions, and independent consultants or NGOs in the FRM field. Experts represented both the Netherlands and the US, including the east, west, and gulf coasts of the US, and Washington, DC.

In the two countries, six local case studies were selected to illustrate some of the dominant drivers, rationale, and processes found in literature, workshops, and expert interviews. For each case inquiries were made into the process and development of a FRM strategy, the role of each safety layer in the FRM strategy, and the rationale behind the strategy. Although, the three cases selected in each country might cover a diverse range of issues and contexts, they do not characterize all flood risk management in US or the Netherlands. They do, however help illustrate the findings from literature and interviews. In each case

relevant literature, including reports, papers, and newspaper articles, was consulted and individuals involved in the decision-making process were interviewed.

To analyze the collected data, the findings were interpreted along the lines of the analytical framework elaborated on in the previous paragraph. First the chosen strategies and policy outcomes, as laid down in the prevailing FRM plans and policy documents and distilled from 'shared stories' stated by interviewees, were compared with each other and with the general course of events in FRM in the respective nation. Consequently, the 'drivers identified' were compared too, between each other and with their respective outcomes. Drivers were identified through the study of trigger events, pronounced policy priorities, stakeholders involved and, where possible, financial flows.

Finally, the similarities and differences in both drivers and outcomes were used to picture the relation between certain drivers and outcomes.

4. CASE STUDIES AND THEIR CONTEXT

4.1 Flood Risk Management in the Netherlands

The Netherlands is one of the world's most densely populated nations with 16.7 million people (UN, 2011) living on 41,864 square kilometers (16,164 sq. miles). Roughly 65% of the Dutch Gross National Product is produced in the most flood prone regions of the Netherlands, which lay at some places several meters below sea level. One quarter of the Dutch land surface is below sea level and almost sixty percent of the Dutch land surface (i.e. excluding the Wadden Sea, the IJsselmeer and other open waters) is susceptible to flooding (Deltares 2011). Geographically, the Netherlands is the North Sea delta of three major European rivers: the Rhine, the Meuse and the Scheldt. Almost twenty percent of the total area of the Netherlands is water, and much of the land has been reclaimed from the North Sea in efforts which date back to medieval times and have spawned an extensive system of dikes. Through the centuries, the landscape of the country has been shaped by many floods (Yska 2009). After the construction of several large scale flood defense systems, the Dutch coast line has been shortened to 350 kilometers and all flood prone regions along the coast and the rivers are well protected by contemporary dunes and dikes. Since the last flood disaster in 1953, safety standards are set by law, ranging from to a flood that has a 1:1250 year chance of occurring in any given year to a flood that has a 1:10.000 chance of occurring in any given year. In 2010 the Delta Program started, with the aim to future-proof Dutch flood risk management. The Delta Program overarches different ministries and is detached from political processes.

4.1.1 Institutional Framework

In the Netherlands, 25 water boards are responsible for water quality, water quantity and flood prevention (safety layer 1). They have their own tax base and do not receive any allowances from the national (or any other) government. Provinces are the principal authority for the designation and standardization of secondary flood defense systems (levees for compartmentalization, considered as layer 2). This stems from their responsibility for outlining the potential and the boundaries for spatial planning in their territory. Provinces are dependent on the national government for the vast majority of their income. Municipalities are amongst others, responsible for the detailed spatial planning in their jurisdiction, including the management of small water bodies and the ratio of paved to unpaved surfaces. On these issues, close collaboration with the local water board is needed (Helpdesk Water, 2013). Safety regions are new in the Dutch institutional system (2010) and responsible for regional emergency response and managing risks and calamities in their territory. Safety regions get the main part of their funding from allowances paid by municipalities. The most important instrument to control and maintain the primary flood defenses of the Netherlands is considered to be the Waterwet. It sets a stringent standard for flood safety based on projected water levels and wave impacts that dikes should be able to withstand. Every six years, the integrity of the levee system is assessed and, if necessary, mended in the flood protection program to maintain the required level of flood safety (HWBP). Because of the carefully balanced groundwater levels and impermeable clay soil in parts of the country, discharging storm water is a critical concern. This was addressed in the fourth memorandum on water management (NW4).

4.1.2 The Case Studies in the Netherlands

The three Dutch municipalities of which the FRM strategies were studied for this research were Kampen, Dordrecht and Almere. Kampen is a little medieval town situated in the IJssel delta. The waterboard implemented innovative solutions, some on a regional level, some together with the municipality, all focused on the prevention of floods without altering the historical character of the region too much. Dordrecht is a larger town, in the Meuse delta. Dordrecht faces flood risk from both the sea and river and has a city center listed as heritage that is partially build outside the dikes. These outerdike areas are officially not the responsibility of the water board and caused the municipality to actively engage in FRM and take measures for the city as a whole. The current strategy in Dordrecht is encompassing, covering prevention, protection an preparedness. Almere finally, has no historic center but was built on reclaimed land in 1978. The probability of flooding in Almere is very low, because of the high dikes protecting the polder. The consequences of a flood would be very high because of the high population density and the 'bath tub'-characteristics of the cities' location. Officially, all organizations involved are aware of the flood risk and in terms of preparedness there are evacuation plans written. However, because of the low probability no real urgency is felt and the water board, responsible for dike safety, actively conveys the message that all inhabitants can feel safe.

4.2 Flood Risk Management in the United States

The United States (US) population is roughly 317 million people, most of which live on the contiguous 48 states covering 7,663,941 km2. It is difficult to estimate the total flood risk exposure in the US (Galloway et al. 2013). The population living within a "special flood hazard area," (SFHA) or an area that would be inundated by a "100-year flood", is estimated to be 18 million people or 6%. Roughly 7 million of these are located coastal SFHAs and 11 million are in riverine SFHAs (RAMPP 2012). This number does not reflect the population that lives behind the roughly 161.000 km (100.000 miles) of dikes or dams in the US (this is unknown), though it is estimated that roughly 55% of the US population lives in a municipality with a dike (Boyd 2009). Unlike in the Netherlands, the US faces significant threat from many other natural hazards including tornado, drought, wildfire, blizzard, landslide, and earthquake which all require similar planning, response, and recovery efforts continuously. Flooding, however, is ranked the highest in terms of loss of life and damages—with an estimated $8billion in damages annually (National Weather Service 2013). The US has experienced many floods over its more than 200-year history. What is often described as the largest and most destructive event was the Great Mississippi Flood of 1927.

4.2.1 Institutional Framework

In the US, the US Army Corps of Engineers (USACE) is the federal agency principally responsible for flood prevention, by helping local communities to assess risk, fund, and build flood risk reduction projects. They also perform inspections on dikes in the federal program and are responsible for maintaining roughly 13% of the country's dikes (ASCE 2013). The remaining 87% is operated and maintained by local agencies or water boards. The Federal Emergency Management Agency (FEMA) is responsible for administering the National Flood Insurance Program (including mapping) (NFIP), Hazard Mitigation Planning guidance, and for federal coordination of preparedness, crisis response, and disaster assistance or recovery (Carter 2012). FEMA does not have regulatory authority over state and local spatial planning, but it does provide guidance and funding assistance for states and communities to implement hazard mitigation plans that reduce disaster losses. Participation in the NFIP, thus, is voluntary (Galloway et. al 2013); however communities that do not participate are not eligible for disaster relief funding or subsidized insurance. Local governments have primary decision making authority over spatial planning, including the choice of whether or not to write and implement a hazard mitigation plan or to participate in the National Flood Insurance Program. State governments can share the cost of construction, operations and maintenance of "preventative" measures, can guide (but not direct) land use decisions and they also typically provide emergency preparedness and response assistance to local communities when local financial resources become exhausted. Though it has no regulatory effect, the objective of the Unified National Program for Floodplain Management (1994) is to encourage the wise use of floodplains. The four strategies supporting the UNF might be considered as a "layered" approach, parallel to the MLS concept.

4.2.2 The Case Studies in the United States

The three American municipalities of which the FRM strategies were studied for this research were Stockton (California), Valmeyer (Illinois) and Natomas (California). Stockton is a city in Northern California close to the Joaquin River. To deal with …

5. ANALYSIS

5.1.1 General observations and interpretation

The first observation from this research is that risk is a relative concept. Obviously, the national interpretations of risk are captured in overarching regulatory frameworks that, by default, limit the operational perspectives of local decision makers. The levels of risk that are generally considered to be acceptable in the United States and the Netherlands lie apart by a factor of hundreds. Although the FEMA 1/100 standard for flood insurance is often criticized for being too low; practice too reflects the difference between the two countries in what is considered to be 'acceptable risk'.

Also, the experience that communities have with flooding seems to influence the choice of measures to implement as well. Of course, agenda setting is easier experiencing some sort of urgency, for instance after experiencing a flood. However the implemented policies without experiencing a (severe) flood seem more balanced. Although in theory, mitigating measures in preparedness, urban planning and prevention can be combined into one, most optimal, strategy. Practice shows that an effective combination of these three different ways of mitigating risk has many more snags in the institutional realm. Time is needed to carefully solve issues like the scale of each stakeholder and the division of costs of implementation and maintenance. Kampen suddenly was in a hurry to implement mitigating measures after 1995 and did not consider other options than flood walls, albeit creative ones. Similar Valmeyer made a rigorous choice in relocating the entire town after the Great Mississippi Floods. Both of these decisions were easier and faster than a combined MLS strategy, because only a limited amount of local / regional authorities needed to get involved. In Natomas a nuanced discussion amongst many stakeholders initiated by changing regulation led to a 'complex multifaceted strategy'. Similarly in Dordrecht, time was taken for a broad discussion including all stakeholders and an explicitly choice for a differentiated mitigation strategy was made. So, slow urgency is needed to implement the balanced FRM strategies based on all three layers of MLS.

Obviously, when talking about long lasting and erratic drivers in FRM strategies there is a personal factor that should be taken into account. In San Joaquin County, the leadership from the now-retired head of emergency operations played a very active and leadership role working alongside many of the local reclamation districts (water boards) over the course of 30 years. Opposite to that, in Almere a lot of time and money was invested in the integration of Safety Layer 3 in the rest of FRM practices. However, if there is no event to respond to and no institutional or personal involvement to safeguard the yields form those efforts, evacuation plans will disappear in desk drawers and standing agreements will slowly be forgotten.

5.2 Observations and interpretation on Safety Layer 1 - Prevention

Prevention is still the most popular FRM measure in both countries. Mainly because, in both countries, it is obligatory to meet safety standards that are measured in terms of hydraulic loading or water surface elevations. Although in the US these standards are not mandatory, there are various incentives from different programs that render it rather impossible in both countries, to comply with regulation without using preventive measures from layer one. Both the Dutch water boards and the US Army Corps of Engineers have historically used preventative measures for "dry feet" and "flood control," these cultures can be difficult to change (RIVM 2004, Pols 2007, van den Belt 2013). Prevention measures in the US can be built specifically for economic or financial reasons; removing the city from a floodplain relieves your inhabitants from the obligation to take costly, individual FRM measures. In the Netherlands there is no direct financial incentive like this. Of course in both countries the drive to attract economic investment

and maintain a desirable place to live requires preventing floods. In both Dordrecht and Kampen flood defense systems were carefully chosen not to ruin the character of the medieval town centers –ruling out, for example, a big flood wall.

There are many coastal communities in the US that must adopt other measures or other combinations of measures in addition to Safety Layer 1, since the demographic density along the 50,000 km Atlantic coast line (in contrast to the 350km Dutch coastline) makes it economically infeasible to fortify the coast like in the Netherlands. The contrary is also true; in dense urban areas with significant infrastructure and particularly where there is already a preventative measure like a levee, safety layer one is often considered to be the only option. In general, many of the contextual factors witnessed in both the Netherlands and the US add up to a strong support for preventive measures in FRM.

The few barriers found to impact the implementation of Safety Layer 1, are all geographic/demographic. Indeed changing risk, changing demographics and, in the case of the Netherlands, less available space, might explain the recent attention for other than preventative measures.

5.3 Observations and interpretation on Safety Layer 2 – Protection

Where multiple objectives could be combined with flood risk reduction, for example to achieve also environmental benefits or to combine with a residential development, measures from Safety Layer 2 were implemented in both countries. The spatial measures in Dordrecht, for example are all co-financed with previously planned spatial development and green infrastructure projects. Valmeyer would receive already disaster recovery Hazard Mitigation funding from FEMA after the 1993 flood and damage assessment, so the town proposed to FEMA that they use this funding to move entire the town higher up, rather than rebuild in place. On the level of the individual home owners there are no drivers found in the Netherlands to engage in FRM. In the US engagement on this individual level is driven by the NFIP. The size of the Netherlands leaves home owners throughout the country with highly correlated risks and little alternatives for, for instance, relocation. On town level, many things happen. Institutional drivers, here too, are stronger in the US than in the Netherlands. The dispersed responsibilities in the Dutch system might even provide a barrier. Although other Dutch institutions might function as a driver, the financial and political drivers for spatial planning in the Netherlands are strongest.

For measures at regional scale soon require extensive regional collaboration with diverse functional and territorial authorities. It takes large investments in time and effort to successfully streamline the implementation process, which serves as a barrier. Ecological benefits of FRM measures function as a political driver in the Netherlands, while in the US this is an institutionalized driver. The US also knows direct financial gain for regional, spatial FRM strategies. This financial driver is absent for the Netherlands.

5.4 Observations and interpretation on Safety Layer 3 - Preparedness

In none of the cases, preparedness measures were explicitly chosen. That said the US has been very active in emergency response planning since the Great Mississippi Flood of 1927. Although emergency management in the Netherlands will of course act in case of a flood, there is little pronounced attention for flood risk. Unlike in the US, the funding, guidance and assistance for hazard mitigation and preparedness measures is very limited in the Netherlands. ‘Preparedness’ is the Safety Layer where the biggest differences between the US and the Netherlands are found in this research. In the Netherlands only one, political, driver was found, whereas in the US also geographic and institutional drivers were identified for including emergency management in FRM strategies.

The perception in the Netherlands that if the engineers and water boards “do their job” by ensuring proper preventative measures, there is little need to implement measures from Safety Layer 3 is not shared in the US. In the US, while policy does imply that behind the accredited levee there is no need for Safety Layer 2 measures, there has always been an understanding that emergencies do happen. Individuals themselves may not feel a need to prepare, but communities and local governments will always continue

to invest in emergency preparedness and response, no matter the level of prevention (safety standard) that is achieved. Barriers in the institutional realm and in public perception were found in both countries, but more and stronger in the Netherlands – leaving no space for that one political driver to make a change and naturally include crisis management in Dutch FRM management.

5.5 Changing contexts

Times are changing, indeed. The NFIP program in the US has been widely criticized, among other reasons, for in effect being counterproductive and encouraging development in flood hazard areas. The program is also expensive: after Hurricanes Katrina, Ike, Gustav, and Sandy, the NFIP is currently around €18.5 million ($25 million) in debt. In 2012, US Congress passed the Biggert-Waters National Flood Insurance Reform Act that, among other requirements, phases out subsidies and significantly increases flood insurance premiums to more accurately reflect risk by charging actuarial rates (Biggert Waters Flood Insurance Reform Act 2012). To date, it remains to be seen how the law will take form as there has been significant concerns regarding the affordability of flood insurance once the rates increase (ASFPM 2013).

In the Netherlands, the geographic context is the biggest barrier for more investments in dikes and barriers. Preventative measures, needing to grow higher and wider with the increasing risk profiles, take up big parts of valuable and often not available space in the Netherlands. The new Delta Program is currently rewriting the regulatory framework of FRM in the Netherlands. Although not officially instated yet, the new laws will draw away from standards based on probability. By including risk indicators like Life Individual Risk and Group Risk, it becomes possible to mitigate flood risk with measures that target the consequences of a flood. Safety regions will get an obligation to be able to evacuate a certain percentage (tailored for the location) of the population and provinces will get the responsibility to mitigate the potential consequences of a flood with spatial measures and the secondary dike system (Deltaprogramma 2013).

6. CONCLUSION AND RECOMMENDATIONS

In six local situations, set in two different national frameworks, this research studied the rationale and decision making processes behind the selection of flood risk management (FRM) strategies. Within the cultural and regulatory contexts of the United States and the Netherlands, local FRM decisions and strategies were analyzed. Through the process of comparison the processes and argumentations from which these FRM strategies emerged and the variations in the respective outcomes, a picture of the most important drivers and barriers and how they impact policy decisions was drafted. Understanding the underlying logic of policy decisions focusing either on prevention, protection and preparedness can prove essential to recognize biased preferences or barriers and to prevent the implementation of sub-optimal solutions.

Despite the perceived and actual differences in the Netherlands and US flood risk management (FRM), the two share a similar history in the development of their current practices, and the drivers behind decision making in FRM for each layer in MLS are quite similar. This study showed that local decision makers faced with flood risk in their area, do indeed not base their decisions solely on actual flood risk, there are many more factors that come in to play; like the political and financial merits of the chosen measures. In most cases long lasting drivers from the factual kind have more impact than the erratic and certain slow changing factors. Although strong, overarching legislation really makes the difference. The interpretation by a higher authority of what appropriate actions are at a certain flood risk level, has proven to be more decisive for the local implementation of FRM measures than the actual risk itself. The perfect mix that is the ambition of the MLS concept, might indeed facilitate cheaper, safer and more universal results. However it cannot be expected from the local level to single handedly realize these healthy balanced programs. Strong institutional drivers are needed since there are too many, fast changing, mainly political drivers that have large impact on the local level and overrule the ´less urgent´ geographic, risk driven considerations. Due to the legal standards, most policies and implementation activities in the Dutch FRM domain since the 1950s have been targeting the prevention of floods. This legislation by default functions as a barrier for layer 2 and 3 because if the safety standards are met with the use of structural measures, investments in non-structural measures become redundant and can be seen as

unnecessary. Overall, to ensure that in the Netherlands 'alternative FRM measures' will be considered more seriously in the future, new longer-lasting drivers are needed. The current drivers for those layers can often be called erratic and are not steady enough to build long term strategies on. The major changes that are currently being deployed in the, slow changing, institutional realm by the Delta program seem the appropriate way to also ensure the implementation of consequence based measures.

In the US, the USACE has been obliged to consider non-structural measures since 1974, together with the Endangered Species Act and the infeasibility of reinforcing 50,000 km of Atlantic coast line; the factual and slow changing drivers for consequence based FRM strategies seem rather strong. However, both the direct and indirect economic consequences of the 'patchwork quilt' of US regulation are so considerable that they turn into powerful political and social drivers, often in favor of structural measures. In many cases, it is the indirect economic consequences resulting from the regulatory processes that are the driving force behind decision-making in the US and largely the barrier to implementing MLS. The Biggert-Waters National Flood Insurance Reform Act intents to address the adverse financial incentives coming from the important NFIP. However there are inherently also major economic interests tied to the NFIP and whether the Biggert-Waters Reform Act will make it through congress remains to be seen.

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