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Flood safety in the Netherlands: the Dutch response to Hurricane Katrina

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Abstract

In this paper I discuss why the Dutch culture, although highly technological, remains vulnerable to flooding, with no apparent choice except to continue with its historically developed system for flood risk management. I show that this vulnerability is socially constructed. It has arisen as a result of a long history of technological choices, the current political decisions related to financing and a general lack of risk awareness. The question whether there is a need or even a possibility to escape from the present technological lock-in seems to remain out of bounds for a society that imagines flood protection to be absolute. The need for similar absolute protection was demanded in New Orleans shortly after Hurricane Katrina caused extensive flooding there. Because of its circumstances and its much shorter history, New Orleans appears to have an opportunity to deal with flood risk in more creative ways.

Key words: Technological lock-in; Vulnerability; Flood management; Risk management

1. The Netherlands: flood defense as technological lock-in

Ever since ancient Dutch society decided to start draining the coastal wetlands of what is now the Netherlands, it has gradually maneuvered itself into what is now a technological lock-in. This decision to drain began about the year 1000, but evidence of even earlier local efforts also has been found [1,2]. After draining, the land subsided due to physical and chemical processes,[1] so to protect it—and the effort and monies spent—levees were built.[2] When there was no flooding, subsidence increased as deposition of new silt and clay ceased, and the growth of new peat was inhibited. This meant levees had to be raised again, and so on; today the difference between the crest of the levees and the land in some places now exceeds 10 meters (see Fig. 1). Add to this a gradually subsiding geological base[3] and predictions of rising sea level due to climate changes, and one might think the Dutch are in dire straits.

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[1] Physical: drained peaty mud lands contain less water and so decrease in volume. Chemical: drained organic soil oxidizes when in contact with the air, which causes volume loss.
[2] In this text 'levee' and 'dike' are taken to mean the same man-made bund to exclude water from an area.
[3] This is due to the re-establishment of mass equilibrium between Scandinavia and the Low Countries after the end of the last Ice Age. Scandinavia is still bouncing back, having lost the weight of the ice, which causes the Netherlands to subside. Time scale: 10,000 years.

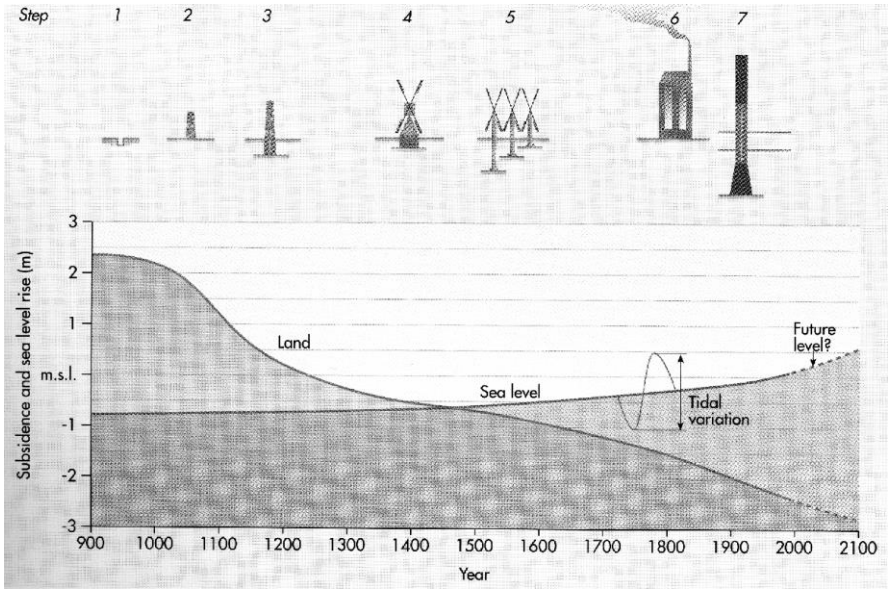

Fig. 1. History of water management in the Netherlands. Source: [1]

The messages communicated by the Dutch water management community, including government ministries, engineering companies, the scientific community, and even the royal family (Crown Prince Willem-Alexander), both at home and on visits to flood-prone areas such as New Orleans, is quite different: "We have everything under control, our land is protected from flooding by the large engineering structures of the Delta works (and we'd like to sell you the know how)." The Delta works and the Dutch polder system are, of course, world-renown, and a justifiable source of pride. What is not communicated at these meetings, though, is the vulnerability of the Dutch system. Possible consequences of choosing this type of flood management are not discussed, even though present-day choices may lead to irreversible worsening of the problem in the long term. However, this is not the whole story of the risks involved in the Dutch flood defense system, as I will explain below.

The 1953 flooding disaster reminded us of what is at stake. The major cities of Amsterdam, Rotterdam, and The Hague were only just spared while a large, relatively sparsely populated area in the southwest of the country flooded, causing more than 1,800 deaths and major damage. As a result, the Delta Commission was established to bring existing flood defense plans up to date. Those plans had been shelved since the 1930s for lack of funds and perceived necessity, in spite of engineers' warnings that a disaster would happen. In the resulting Delta Plan, all tidal outlets in the estuary were to be closed off, except the northern and southern waterways that provided access to the harbors of Rotterdam and Antwerp, respectively (see Fig. 2). Here the dikes were to be strengthened.

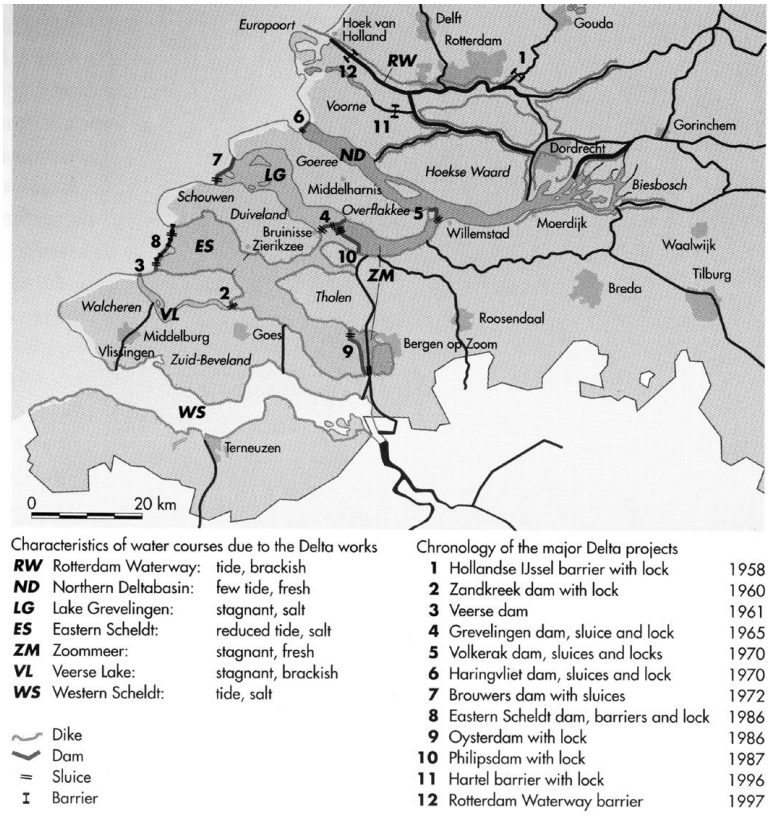

Fig. 2 The Delta Plan. Source: [1]

The 1953 flood also triggered legislative action: higher standards for the design of flood defense structures were incorporated into law. Interestingly, it was 1996 before the latter finally took place. Apparently another reminder was needed, as in 1993 and again in 1995 the major rivers nearly burst their banks and 200,000 people were evacuated. However, in practice, the standards were implemented from around 1960. On the basis of expected damage (and I suspect a great deal of political wrangling as the financial consequences became clear), it was decided that all flood defense structures should be designed to a probability of failure of once every 10,000 years in the most densely populated areas that are subject to flood risk from the sea. Less densely populated coastal areas should be protected to once every 4,000 years. Areas subject to flooding from rivers have lower standards: once every 250 to once every 3,000 years (Figure 3). In comparison, it is estimated that flood protection levels in New Orleans are designed for catastrophic flooding approximately once every 50 to 100 years [3]. This is also the usual order of magnitude in the rest of Europe.

So, is the Netherlands finally safe from flooding by virtue of these high levels of protection? No, it is not, and there are several reasons why. On the face of it, the remaining chances of failure (once every 10,000 or 4000 years) are too small to consider. However, on a human time scale it means a chance of at least one percent of the population having to face flooding once in its lifetime—a tiny percentage, yes, but not negligible. More importantly, if things do go wrong, in many places they are apt to go badly wrong. Millions of people live several meters below sea level. In the worst scenario, parts of these areas will be below several meters of water within a few hours, and many casualties will result. Economic, cultural, and societal damage will be unimaginable.

There are many uncertainties attached to the implementation of these flood safety levels. The combined uncertainties in the hydraulic and engineering calculations are at least an order of magnitude, not counting uncertainties we simply do not know about. This means that if 1/10,000 were actually closer to 1/1000, then the chance of flooding occurring during a lifetime increases 10%.

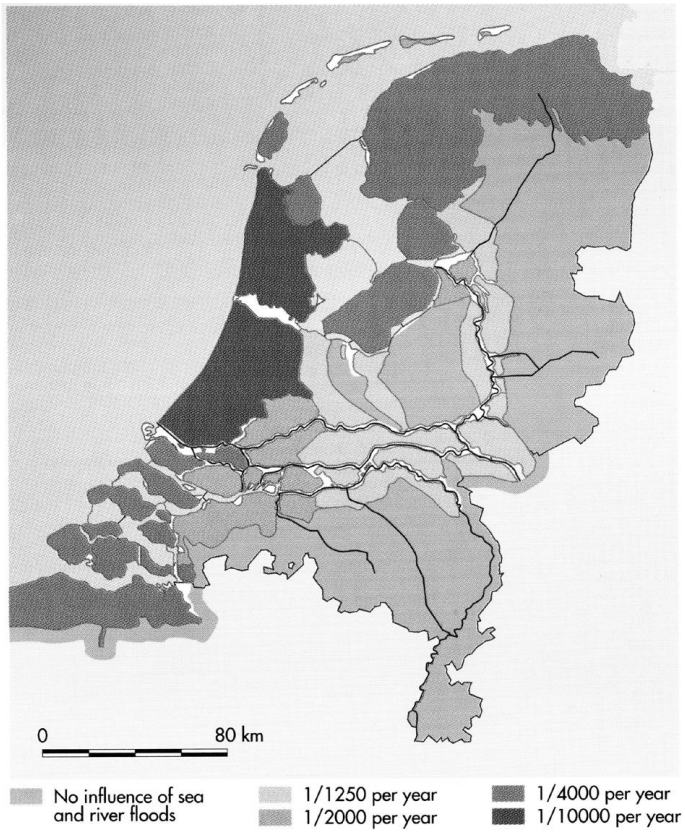

Fig. 3. Legal requirements for levels of protection from flooding in the Netherlands. Source: [1]

Added to this, the legally required tests of the safety standards are limited for practical reasons to the height of the dikes compared with expected water levels. Since overtopping is only one of several failure mechanisms (others include soaking and undermining), the actual strength of the dikes remains unknown. This means it is also not known whether the dikes truly meet the agreed safety levels even if they are high enough. To make matters worse, recent investigations have shown that protection standards may exist in theory, but in practice, funding to maintain or improve structures is not sufficient. Only 50% of the dikes can be shown to actually fulfill the legal height requirements, for 35% it is unclear if they do, and 15% certainly do not [4]. A full-scale investigation of all failure mechanisms found that among the 16 polders completed (out of 53), with one or two exceptions the calculated protection was estimated to be lower than legal standards, often by a factor 10 or even 100 [5].

On top of defaults in the protective infrastructure, there are the uncertain effects of climate change. In the long run, living in this low country seems an untenable situation because sea levels will continue to rise and land levels will continue to fall—a vulnerable technological culture indeed [6]. The Netherlands truly finds itself in a lock-in because there is no question the entire population in low-lying areas can move elsewhere. As a Dutch civil engineer put it recently: “There is one big lesson for the Netherlands from Katrina: we should never allow this to happen. If you want to live in these areas, you have to protect them” [7]. He should know that the word ‘never’ does not exist in risk management, but his message is clear. Unfortunately, it seems that national politics have not caught on to this message. Any discussion of the existence of a small—but not negligible—risk of flooding seems to be taboo, and the problem of non-compliance with legal standards even more so. The next section explains why this political lock-in may have as great impact on for long-term vulnerability as the technological one, for it prevents fundamental discussions of ways out.

2. The Netherlands: flood risk management as a political lock-in

Politicians usually blame low political priority on a lack of popular support for (spending money on) flood defense measures. Recent inquiries have revealed that, indeed, most members of the public are not interested in discussing water issues because they are confident that things are being looked after properly [8]. The general population leaves it to the national government to decide whether more money is needed for flood defense. But politicians are more concerned with immediate and visible issues, such as national health, unemployment, or the fight against terrorism. Only for short periods is the public confronted with the real possibility that 'things can go wrong', e.g., after the near-flood events of 1993 and 1995 in the Rhine and Meuse rivers, or after Hurricane Katrina in New Orleans. Reactions are strong, but soon forgotten when other events claim the limelight.

Public confidence in technical solutions and technocracy was reinforced by the Delta works [9]; the public believes that these constructions ensure that a disaster like the 1953 flooding will never happen again. Politicians emit the message that "we have never been protected as well before," and "nowhere is flood protection raised to such high standards as in the Netherlands" [10]. After all, they want to be seen to fulfill the public's expectations in terms of providing safety—even if scientific investigations show otherwise. Raising public awareness of the risks that remain is apparently unthinkable. The Director-General Water denies that safety standards are not met: "The Netherlands is the only country in the world where standards for flood protection have been legally determined. Our society accepts a probability that once every 10,000 years the protection will fail" [11].

Water professionals are trying to break this vicious circle by making public the risks as they perceive them. They calculate probabilities of failure to be much higher than are legally required [4,5]. They estimate economic consequences, and show that they have multiplied since the Delta Commission set protection levels in 1960 [5]. However, alternative legal embeddings of flood defense levels will face exactly the same political difficulties as the present system. Safety levels, by definition, reflect the compromise choice between efforts for protection and implicitly accepted residual risks. When safety levels cannot be politically discussed due to fear of contradicting the public conception of absolute security, a revision of flood defense policy is unattainable. This represents a political lock-in, which exists right along with the technological lock-in demonstrated in Section 1.

The consequences of these positions are (1) a low priority on spending money for flood defense; (2) politicians arguing that flood protection is only one of many objectives; (3) proposals to combine flood defense with (more economically advantageous) land uses; and (4) arguments that money preferably should be found elsewhere than in the national treasury. Unwillingness to recognize risk also hampers the development of radically different solutions, as the next section will show.

3. Room for rivers: release from the technological lock-in?

Throughout history, Dutch flood defense has relied on civil engineering structures to evacuate and exclude the water. Periodically, water reclaims some of the space it has lost, only to be excluded yet again. Section 1 explained how this engineering-based paradigm resulted in a seemingly inescapable technological lock-in, where the only choice available is to continue with ever-growing dikes and dams. In Section 2 it became apparent that the political will to sustain even this solution is lacking, judged by the failure to allocate funds for maintenance. At the same time, political discourse would have the general public believe that the legally defined high safety standards are implemented, and that they are therefore (absolutely) safe. Most of the time the existence of risk is a taboo subject. If flood risks do get on the agenda, as when Katrina flooded New Orleans, the production of 'evacuation plans' is the government's answer (see Section 4).

All is not lost, however, as new thinking on flood management has been developing. Instead of 'controlling' floods as the engineering paradigm prescribes, the idea has been gaining ground that flood water should be 'accommodated.' This new paradigm could provide an opportunity to escape from the technological lock-in. This new thinking may have begun in the 1970s when the Delta Work's last proposed closure, the Oosterschelde Dam, was successfully challenged by an ad hoc

alliance of fishermen, nature conservationists, and ecologists working for the Ministry of Transport, Public Works and Water Management. Bijker argues that the construction of the Oosterschelde dam, the biggest dam of the Delta works, would radically change water engineering in the Netherlands [9].

Ecology was added as a second objective for projects initially established for flood protection. This also happened with river flood management. In 1987 a new vision to combine nature development and flood protection was presented, Plan Stork [12]. Floodplains in use for grazing or brick making had to be redeveloped as an "original floodplain habitat." The large-scale reshaping of the floodplain needed to implement these ideas would at the same time provide more space to convey a river during a flood. Processes that occur naturally in delta areas should be allowed to happen so floods would no longer be as threatening. As a result, reinforcement of dikes would become unnecessary, and both engineers and nature proponents would be happy. An escape from the control paradigm looked possible.

Implementation of these ideas had just begun when the near-flood events in the Rhine and Meuse rivers in 1993 and 1995 triggered calls for more safety. These events provided the push to bring at least the most critical dike stretches up to standard. These near-misses also reinforced the idea that the potential capacity of the system was limited and more space should be found. The water community now began to pay greater attention to the basic ideas of Plan Stork, and it was written into a national "Room for Rivers" policy [13].[4] Contrary to Plan Stork, in the 'Room for Rivers' policy the creation of space for water is presented as the first objective rather than nature development (see Fig. 4).

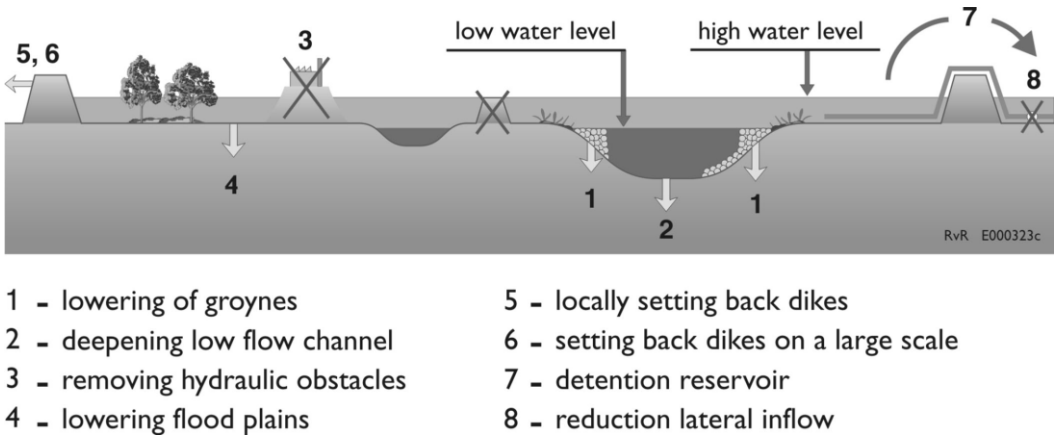

Fig. 4. "Room for Rivers" alternatives to increasingly higher dikes. Source: [23]

In the early 2000s, Plan Stork's aim to create dynamic nature areas was weakened further and reformulated as "enhancing spatial quality," to indicate that multiple interests should be taken into account as well as nature, including housing, recreation, and business. Since "spatial quality" is a concept that can be interpreted in many ways, it also offers grist for the argument to fund flood measures through the sale of floodplain land for use in housing development [14]. It should be emphasized that legal flood protection standards did not change, thus limiting negotiating options for projects that implement the new ideas. One reason why flood policy was linked with spatial policy (including nature development) may have been to find alternative ways of financing flood management projects, including funds from other ministries. As a side effect, maintaining flood defense standards becomes dependent on decisions made in other policy fields where flood protection arguments are merely one of many to be considered. The practice of project implementation can be quite different from the policy objectives.

[4] The correct translation of *Ruimte voor de rivier* is *Space for the river*, but Dutch policymakers prefer to use *Room for Rivers* when using English. We follow this preference.

The "Room for Rivers" policy gives an opportunity to introduce more resilience, in this case by over-dimensioning measures in order to create space for water and flexibility to cope with climate change and other uncertainties (such as in hydraulic calculations). In practice, the outcome of negotiations between the interested parties is usually to fine-tune the proposed works in such a way that they use as little space and cost as little money as possible. The legal water level reduction objective is achieved, while spatial quality is of secondary importance[15]. This is not surprising given the high population density and resulting pressures on the available land and the observed reluctance to spend money on flood defense. This implies that although the concept of accommodation is incorporated in the "Room for Rivers" objectives, in the implementation phase the control paradigm dominates.

Hence technological lock-in remains for the moment, although space has been created to think differently about flood management. Whether the 'accommodation' paradigm is a viable alternative in technical, political, and financial terms has not yet been thoroughly investigated. Nor is it clear what society's reaction to a next (big) flood disaster will be: more emphasis on control or a change in the balance between the two paradigms.

4. Hurricane Katrina: possible release from political lock-in?

The Dutch water world was truly shaken by the flooding of New Orleans following Hurricane Katrina. Could this happen in the Netherlands, and if so, how well-prepared would the country be? One of the concrete actions resulting from Hurricane Katrina flooding in New Orleans was a national conference in the Netherlands entitled "Lessons Learnt [from] New Orleans" (in English!) aimed at high-level civil servants, mayors, and politicians and organized jointly by the Ministry of Home Affairs and the Ministry of Transport, Public Works and Water Management. From conference documents, it appears that the only lesson the organizers want to communicate is the importance of evacuation planning and preparation, not the importance of maintaining the existing infrastructure. After all, the politicians say, our defenses are very secure but "we have to think about how to deal with the remaining risks, e.g., through evacuation planning" [11].

According to the scientists represented at the conference, the actual situation is less rosy but they arrive at a similar conclusion: "Our defenses are not as strong as we think, so it is time we make sure we are prepared for an eventual evacuation" [16]. The chairman of the Union of Waterboards does not agree on this fundamental point: "Evacuation in the Netherlands is much more difficult than in New Orleans, and in some areas virtually impossible" [17]. It appears his point was not given much consideration at this high-level policy meeting.

Hurricane Katrina created a window of opportunity to engage in a fundamental discussion of flood risks and how Dutch society wants to cope such risks – in other words, to try to escape the political lock-in. Unfortunately, it seems as though politicians continue to deny that there are any flaws in the flood defense infrastructure. It remains to be seen whether the detailed evacuation plans being prepared at the moment will confirm the chairman of the Union of Waterboards' conclusion that evacuation from the major cities in Holland is impossible. Will politics give this result any attention? If they do, it is quite likely that flood risks will have disappeared from the top of the agenda by then.

5. The Netherlands, New Orleans, and the future: lessons and learning

When a Dutch civil engineer said, "If you want to live in these areas, you have to protect them," the reaction might have been: "This is an engineer, he wants to keep his job." However, the same message also comes from a U.S. architect: "Designers from outside think: shrink the city to manageable flood risk. However, people want to go home, no matter how big the risk. This is reality. The game of making the city smaller is over! So we need to protect the big city against category 5 hurricanes, and make the flood risk visible" [18].

This awareness of flood risk is lacking among the general population of the Netherlands. In most Dutch minds, they are safe—in spite of government-funded PR campaigns that say we need to live with water and find more space for it. So the lock-in also exists in people's minds. People who are not aware of the flood risks they face vote for politicians who are reluctant to spend more money, or will only do so if they can "score" with highly visible results. Common to both the Netherlands and New Orleans is the impossibility of preventing human occupation in flood-prone areas. This implies having to live with flood risk—no matter how much the engineers, the politicians, and the public want to make sure flooding never happens. Decisions about how to manage this situation must balance resistance and resilience, rigidity and flexibility, as well as being acceptable from a political and funding perspective.

And what is the importance of knowledge when it comes to decision making on flood management? Immediately after Hurricane Katrina, a New Directions Katrina Research Workshop entitled "Cities and Rivers II, New Orleans, the Mississippi Delta, and Katrina: Lessons from the Past, Lessons for the Future" asked the question: "How we can incorporate knowledge with politicians' gut statements of 'we will rebuild no matter what'?" [19]. The requirements and questions expressed here both meet and can be answered in the design of solutions. "Policy and process meet in design, we need to get to a concrete level" [20]. Through innovative solutions, vulnerability can be changed into something positive. "Vulnerability is not to be taken as something purely negative . . . it is even an important asset of our technological culture as a prerequisite for living with the quest for innovation" [6].

Solutions need to reflect the remaining risk, and Chris Zevenbergen gives a concrete example of how "to combine levees with controlled overtopping in certain, multifunctional areas. This keeps the awareness of flood risk alive, and might also stop people returning to those areas" [21]. However, recent attempts to introduce this idea in relatively sparsely populated areas in the Netherlands failed because regional and local decision makers, as well as the affected population, do not wish to be subject to higher probabilities of flooding than other parts of the country [14]. The fact that flood protection standards are variable anyway, and that these areas that would flood before others, does not seem to have sunk in, which is not surprising if flood risks are not acknowledged in general.

Provided the development of solutions is established as an open learning process, including smart process management, dealing with concrete situations focuses experts' minds and forces them to work in an interdisciplinary way. A concrete reason, such as the destruction of entire areas of New Orleans in the wake of Hurricane Katrina, makes dialogue easier and invites negotiations with and between politicians and other relevant social groups. I would hope, therefore, that the response to Hurricane Katrina in New Orleans proves to be a flexible, innovative, and learning situation, as the city does the best it can now and improves as time brings new experiences. New Orleans has a real opportunity to avoid the lock-in that the Dutch seem to have put themselves into, and not allow itself to fall into the Netherlands' type of "state-of-the-art protection" [22].

6. Conclusion

I have shown the Dutch culture to be a technological one, vulnerable to flooding. At least for the moment it is unable to escape its control paradigm for flood risks. I have shown that this vulnerability is socially constructed, that is, through a combination of managerial and political decisions on financing structures and lack of risk awareness. Other cultures have followed a different historical path, and therefore have not made the same decisions. The challenge seems to be to find solutions that are consistent with the local and regional culture, and to avoid locking-in, technologically or politically. Wiebe Bijker showed,

> Although the Dutch and American histories of coastal engineering stand out from other histories by the central role that natural disasters played in shaping coastal engineering practice, the way they did so is strikingly different. The American practice seems to focus on predicting disasters and mediating the effects once they have happened; the Dutch seems merely aimed at keeping the water out. [3]

The task is, therefore, to ground solutions for a "Newer Orleans" into New Orleans culture.

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Anna Wesselink was trained as a tropical land and water development engineer, but moved into water resources research and management. This took her to the UK, the Central African Republic, and to Madagascar. In order to reflect on her professional practice, she started a Ph.D. on the decision-making process in flood management in the Dutch Meuse, with particular attention to the integration of expertise, the participation of relevant social groups, the ways integrated assessment is framed, and processes of (social) learning and negotiation. In her Ph.D. she integrates natural and technical sciences and the humanities.