Troubled waters: an institutional analysis of ageing Dutch and American waterway infrastructure

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Keywords; inland waterway transport, infrastructure, IAD framework, institutional analysis, value

Abstract

Waterways are one of the oldest systems for the transportation of cargo and continue to play a vital role in the economies of some countries. Due to societal change, climate change and the ageing of assets, the conditions influencing the effective functioning of these systems seem to be changing. These changing conditions require measures to renew, adapt or renovate these waterway systems. However, measures with the sole aim of improving navigation conditions have encountered resistance, as the general public, and stakeholders in particular, value these waters in many more ways than navigation alone. Therefore, a more inclusive, integrated approach is required, rather than a sectoral one. Addressing these contemporary challenges requires a shift in the traditional waterway authorities' regimes. The aim of this study is to identify elements in the institutional setting where obstacles and opportunities for a more inclusive approach can be found. Two major waterway systems, the American and the Dutch, have been analyzed using the Institutional Analysis and Development framework to reveal those obstacles and opportunities. The results show that horizontal coordination and a low pay-off for an inclusive approach is particularly problematic. The American case also reveals a promising aspect – mandatory local co-funding for federal navigation projects acts as a stimulus for broad stakeholder involvement. Improving horizontal coordination and seizing opportunities for multifunctional development can open pathways to optimize the value of waterway systems for society.

1 Introduction

Waterways were one of the first infrastructural systems to transport people and goods. A waterway system usually consists of linked rivers, canals and lakes. Many of these systems have been expanded, altered and improved to serve the needs of transportation, and although transportation over water has lost its prominence in some countries, it remains a vital part of society in many others (Central Intelligence Agency, 2011).

Currently, the institutions responsible for waterway systems face a threefold challenge. In societies where these systems were developed a long time ago, crucial elements of these systems, such as navigation locks, dams and weirs, are ageing (Heijer et al., 2010; Hijdra et al., 2014). Secondly, climate change is altering operational conditions (Beuthe et al., 2014; Jonkeren et al., 2011; PIANC, 2009), and thirdly, society sees the role of these waters differently to how it did in the early years of their

development (Mount & Bielak, 2011; Pahl-Wostl et al., 2010; UN Water and Global Water Partnership, 2007). The ageing of assets and climate change have together created a need for action: a changed perspective on these networks brings with it the challenge to 'fit' the waterway systems to the contemporary needs of society and build on the systems' value.

The significance of these waterway systems for society and the need to address contemporary challenges would be of no concern if adaptation to this new context were without effort. However, these systems and their related institutions have often had long histories of sectoral optimization and are still aligned to this. Examples of such sectoral optimizations are the construction of dams and locks to ensure navigation depth, the dredging of navigation channels, and the construction of artificial river and canal embankments. Waterways, and more in general infrastructure systems, can be described as large socio-technological systems. Due to their physical attributes and related institutions such systems typically show signs of inertia (Geels & Schot, 2007).

The situation described above is true for countries such as Germany, France, Austria, the Netherlands and the United States. All have inland waterway networks of significant importance, ageing assets and strong central agencies governing these networks. The ageing of assets, climate change and changing societal requirements are driving these agencies to consider measures to renew, adapt or renovate these waterway systems. However, measures with the sole aim of improving navigation conditions have encountered resistance, as the general public, and stakeholders in particular, value these waters in many more ways than navigation alone (Pahl-Wostl, 2007). Beyond reducing resistance, society can be served in a broader way (Hijdra et al 2014). Interconnecting issues and broadening the scope of optimization can reduce inefficiencies and provide new opportunities. Examples are that attractive waters and waterfronts influence real estate value in a positive way, or, economies of scale in shipping affects natural river dynamics, flooding patterns and ecological balances in a negative way. Perhaps a very straightforward example of optimization beyond national agencies mandate is in contracting. Contracting of dredging of national waters could be combined with dredging of local waters delivering economies of scale. The examples show inclusiveness can take many forms and benefits. Therefore, a more inclusive, integrated approach is required, rather than a sectoral one.

An international group of waterway experts from the Permanent International Association for Navigational Congresses (PIANC) reviewed which elements could be taken into account in such an inclusive approach (PIANC, 2013). The committee was explicit that waterways today are valued for many more reasons than in the age when they were developed. Table 1 shows a wide variety of functions and values related to waterways. Typically, these functions and values do not relate to a single authority but to a wide variety of institutions and action arenas. The elements in table 1 have been categorized into four groups representing four major views in literature. However, as many of the elements in the table do have aspects that relate to more than one category, the table should be considered as a help to provide some overview, rather than the exact categorized division.

Table 1 Wide array of waterway uses and functions, non-exhaustive inventory by PIANC working group on 'Values of Waterways' (PIANC, 2013).

Waterway as a logistical corridor	Waterway as a socio-geographic element	Waterway as a water resources system	Waterway as an ecological system
Recreational boating	Recreation at embankments	Drinking water	Nature
Cargo transportation	Administrative border	Cooling water	Ecosystem services
Passenger traffic	Social coherence	Industrial process water	
	Religious values	Irrigation	
	Housing	Water management	
	Historical values	Hydropower	
	Landscape/aesthetics	Water storage	
	Cultural identity	Fisheries	
	Military purposes		

A more inclusive approach inevitably relates to the mentioned wide variety of institutions and action arenas. The aim of this study is to identify elements in the institutional setting where obstacles and opportunities for a more inclusive approach can be found. Two illustrative cases have been analysed, the USA and the Netherlands, to identify such obstacles and opportunities. Both systems are of great socioeconomic importance and both systems are highly optimized for cargo transportation. For the analysis the Institutional Analysis and Development (IAD) Framework has been applied. This framework is particularly useful for the analysis of these kinds of situations, as it was developed to understand decision-making by institutions, their rules and actors. Fresh empirical data could contribute to the debate in this area, as waterway systems as a means for transportation have received little attention to date.

2 Theory

Waterway systems can cover large areas of land, cross administrative borders of various kinds and link to many economic, social or environmental aspects of society. As a consequence, a myriad of institutions could be involved in these networks' development issues. These institutions could be national, regional or local. Understanding how these institutions form decisions for waterway development is therefore crucial to finding opportunities and obstacles to an inclusive approach.

A variety of theoretical frameworks can be used to gain understanding in decision making when a broad group of actors is involved. Stakeholder identification and analysis techniques, as for instance described by Bryson (2004), can be very helpful in this. Policy network analysis, perhaps the most common framework, can be used to study how formal institutional and informal linkages between governmental and other actors determine policy outcomes (Rhodes, 2008; Risse-Kappen, 1996). Multi-level governance analysis typically recognizes that governance occurs across scales and involves both

public and private actors in a variety of settings. The multi-level refers to the interdependence of governmental bodies operating at different territorial levels, and the governance part reflects the interdependence between governmental and non-governmental actors (Bache & Flinders, 2004). An incrementalist's view, muddling through or positional analysis have a less broad reach, but can be helpful in multi-actor cases where comprehensive policy development and implementation is lacking (Marsden, Ferreira, Bache, & Flinders, 2014). The IAD framework, provided by Ostrom (Ostrom, 2005; 2010), is a useful framework for analysis of multi-actor settings with a somewhat different perspective. What differentiates the IAD framework from other forms of organizational analysis is the focus on rules associated with action arenas. It is this type of analysis that has been selected for this study, as it is expected that the in-depth analysis of rules around a specific action arena could reveal the specific opportunities and obstacles for an inclusive approach.

By following the steps in the IAD framework and taking the action arenas as the unit of analysis, the analysis will systematically follow the path of decision making for a project. This path can be followed from policy level to implementation. When these action arenas and associated rules are shown against the background of stages for project development, the results can provide useful pointers for practitioners on where and when to act in order to improve the broad societal value of projects. Classic stages of projects which can be distinguished are: agenda setting, programming, planning, and implementation (Boal & Bryson, 1987; Bryson & Delbecq, 1979).

Within the IAD framework, institutions are defined as a set of prescriptions and constraints that humans use to organize all forms of repetitive and structured interactions. Institutions are important as they are the underlying determinant of economic performance by forming a society's incentive structures (North, 1993). The IAD framework offers researchers a way of understanding the process of policymaking and collective decision making by outlining a systematic approach for analyzing the institutions that govern action and outcomes within collective action arrangements (Ostrom, 2005; 2010). The IAD framework is particularly suitable for the analysis of waterway development, as related institutions can be considered as a range of action arenas with a multitude of actors and rules.

The IAD framework defines the action arena as the relevant unit of analysis for understanding a system. Figure 2 shows the structure of the action arena.

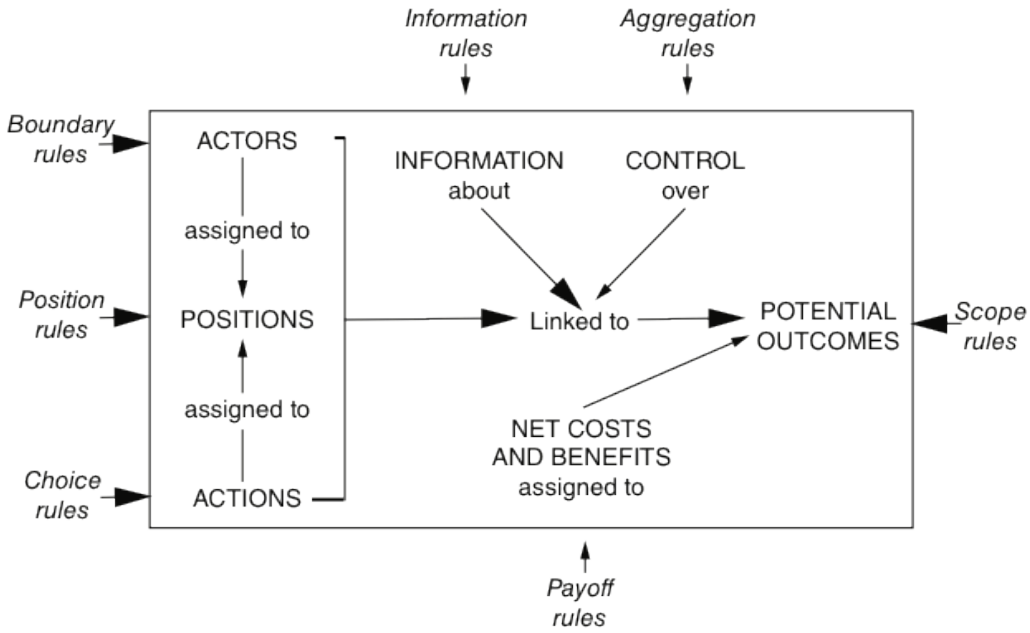

Figure 2 Structure of an action arena and its rules affecting the action elements (Ostrom, 2010)

The action elements are not elements in isolation but are affected by a set of rules. Many rules can often be distinguished, but seven types can be distinguished in a more generalized sense:

(i) Boundary rules that specify how actors were to be chosen to enter or leave these positions;
(ii) Position rules that specify a set of positions and how many actors hold each one;
(iii) Choice rules that specify which actions are assigned to an each actor in a position;
(iv) Information rules that specify channels of communication among actors and what information must, may, or must not be shared;
(v) Scope rules that specify the outcomes that could be affected;
(vi) Aggregation rules (such as majority or unanimity rules) that specify how the decisions of actors at a node were to be mapped to intermediate or final outcomes; and
(vii) Payoff rules that specify how benefits and costs were to be distributed to actors in positions. (Crawford & Ostrom, 2005).

This framework was used to identify obstacles in the Dutch and American systems which create entrapment in the current state and which impede effective response to changing conditions and requirements.

Literature provides little insight into specific waterway infrastructure arrangements. For infrastructure planning in general, coordination in multi-objective settings, and institutional arrangements have been studied, but there seems to be no convergence to best practices (Mishra, Khasnabis, & Swain, 2013; Short & Kopp, 2005). For water management the performance of institutional arrangements is identified through the broad watershed studies of Saleth and Dinar (2004) and Pahl-Wostl et al. (2012).

Saleth and Dinar concluded that the strength of institutional links determines water institution performance and affects water sector performance. They found that links and effective coordination of polycentric governance structures are key to achieving efficient and integrated results for watershed planning. By applying the IAD framework to such governance structures, more detailed insight can be gained about the working of these links and coordination activities.

3 Materials and Method

Many countries have waterway systems of some sort, but quite often such systems are either very limited in extent or limited in use. Some of these systems consist mainly of natural rivers. Institutional inertia or inefficiency related to the management of the navigation infrastructure is not a pressing issue in these countries: efficient freight transportation does not rely on government infrastructure provision.

This is different for countries where inland waterway transport is an important mode of transport and where the management of waterways and related navigation infrastructure is an important factor in safe and reliable transport. Both the Netherlands and the United States fit this principle. These two countries have been chosen as areas for study as both offer a rich and relevant context for investigating the limitations and opportunities for more inclusive approaches. Both have a long history in waterway use and development, and even today these waterways are intensively used for freight transportation. The waterway systems are of significant national economic importance, and both systems have been heavily altered to function properly for navigation. In both countries a significant portion of the waterway assets is reaching the end of its technical lifetime, therefore ageing of assets has become a pressing problem. Both systems are also exposed to climate change issues. Therefore, in both countries, there is a sense of urgency to react to these developments, which provides, in theory, a window of opportunity for breaking the existing lock-in situation.

Both countries have a single central agency responsible for these systems' main arteries and both systems have an extensive system of locks and weirs to maintain navigable conditions. The institutions responsible for the waterways are strong and resourceful organizations, and have a long history of managing and developing these waterways (Lonquest et al, 2014). Ageing of assets and climate change effects play a role in both systems. The general characteristics of the national transportation systems in the USA and the Netherlands are shown in Table 2. In table 3 an overview is provided of different issues at play with regard to ageing for highway, railroad and waterway systems.

Table 2 General characteristics of the American and Dutch freight transportation systems*

Item	USA	Netherlands
Length of infrastructure (km) Highway / railroad / waterway	423.976 km/ 358.667 km/ 34.547 km	6675 km/ 3032 km/ 4346 km
Relative length of infrastructure Highway / railroad / waterway	52% / 44% / 4%	47% / 22% / 31%

Modal split (freight mass) Road/rail/water/pipeline/others or unknown	73% / 11% / 5% / 9% / 2%	62% / 3% / 24% / 10% / 0%
Modal split (ton kms)** Road/rail/water	43% / 50% / 7%	56% / 5% / 39%
Waterway length, federally operated	19200 km	1686 km
Federally operated lock sites / lock chambers	191 / 237	83 / 139
Dominant use Highways / railroad / waterways	Passenger cars / freight trains / freight pushing convoys	Passenger cars / passenger trains / self propelled freight ships
Commodities transported over inland waterways***		
Solid fuels	23%	8%
Petroleum products	28%	19%
Sand gravel and stone	10%	29%
Food and farm products	9%	9%
Chemical products	8%	13%
Iron ore and scrap	6%	7%
Others****	16%	15%
Total	100%	100%

*Data sources: Freight Facts and Figures 2013. Federal Highway Administration and Bureau of Transportation statistics. Bureau of transportation statistics - Centraal Bureau voor Statistiek.
**Pipeline transport not available in tonkm
***Data sources: US -Transportation Facts and information. Navigation and Civil Works Decision Support Center. The US Army Corps of Engineers, November 2012. NL – Bureau Voorlichting Binnenvaart, 2009.
****For the Netherlands this is mainly containerised transport, in the USA containerised transport by barge is almost negligible.

A variety of sources have been used to gather data for the analysis. For general information on opportunities in waterways development and more inclusive approaches, use has been made of the proceedings of the international PIANC working group, studying the variety of functions of waterways in a series of 14 sessions from 2010 up to 2014. Officials from waterway authorities from 6 countries attended these sessions, amongst these countries were the Netherlands and the USA. For a general understanding of the systems in both Dutch and American situation use has been made of observations and documentation of a variety of projects and site visits in both countries, which have been visited during the period from 2011 to 2014.

Table 3 General characteristics of ageing issues in highway, railroad and waterway systems

Typical maintenance	Highways	wear and tear dependent on use and deterioration through weathering
	Railroads	wear and tear dependent on use
	Waterways	dredging dependent on sedimentation patterns
Typical capital assets	Highways	Bridges, tunnels
	Railroads	Bridges, tunnels, yards
	Waterways	Locks, dams, quays
Typical motivations for reinvestment	Highways	End of technical lifetime of assets, Traffic bottlenecks
	Railroads	End of technical lifetime of assets

	Waterways	End of technical lifetime of assets Shipping traffic bottlenecks Changing hydrological conditions.

For in depth analysis of the decision making process and the actual action arenas, a series of projects in both countries has been analysed. These projects were the New Orleans Inner harbour Navigation canal expansion, the Napa river flood projects, and the Miami River restoration, the Beatrixlocks and Lek-canal expansion, the new canal around the city of Den Bosch, and the New lock complex at Eefde. Twenty-two project managers, waterway specialists and contract managers (12 American, 10 Dutch) were interviewed in semi-structured interviews. Furthermore use has also been made of publically available documents and reports, website postings and data from conversations with officials and stakeholders in waterway projects.

On the basis of all gathered data, the action arenas in both countries have been mapped out. The data was structured along the steps of project development phases as both arenas and actors are aligned like this. Vice versa, results can therefore be related to these steps so these are readily for use for practitioners. The data from the semi structured interviews, documents, reports and website postings was used to identify the opportunities and hindrances related to the arenas and associated rules of the IAD framework.

4 Results

American Waterways

Documentation, projects visits and interviews all underlined the central position of the US Corps of engineers in the waterway operation, maintenance and development activities. The US Army Corps of Engineers, established in 1802, is responsible for the vast majority of the waterway network in the US, and all major stretches fall under their responsibility (US Army Corps of Engineers, 2009). The Corps is in essence a military organization which includes a civil branch within which waterway management and development is located (US Army Corps of Engineers, n.d.). Its mission is defined as: ‘Deliver vital public and military engineering services; partnering in peace and war to strengthen our Nation’s security, energize the economy and reduce risks from disasters’ (US Army Corps of Engineers, 2014). The Army Secretary Assistant for Civil Works (ASACW) oversees the activities and determines policies for the navigation works of the US Corps of Engineers (United States Army, 2014). The Secretary of Defense (SoD) is the highest official under the President of the US overseeing the nation’s entire armed forces, including the US Corps of Engineers.

Figure 3 Main waterway network of the US (figure courtesy of US Corps of Engineers)

The network under the responsibility of the Corps is around 19,200 km in length (Figure 3). By law, a local partner must be found to carry the burden of part of the expense of any waterway project to secure federal support. These expenses can be monetary or in kind.

The federal funding comes from the federal budget along with funds raised from the waterway trust fund. These funds come from fuel taxes paid by waterway users. The Inland Waterways Users Board (IWUB) is an advisory board monitoring the trust fund and advising the Army Corps of Engineers and Congress on priorities for spending from the Inland Waterway trust fund. Although the IWUB has an advisory role in the process, congress and the US Corps of engineers rely heavily on the opinion of the Board as was made clear by officials in the PIANC working group meetings.

In the planning and implementation process a wider group of actors comes into view. Local property owners, special interest groups, contractors and local governmental representatives are involved in the planning and implementation phase. The interviewees provided rich data on the wide variety of interactions in these phases. In appendix 2 the variety of arenas, which determine the development of waterway project, are shown.

Dutch Waterways

In the Dutch situation, documentation, website postings and interview data pointed towards Rijkswaterstaat as the main and dominant agency for waterway operation, maintenance and development. This public agency is responsible for all the main arteries of the waterway system (Rijkswaterstaat, 2011). It was established in 1798. The Agency falls under the remit of the Ministry of

Infrastructure and the Environment. The Ministry is responsible for initiating, budgeting and preparing information on prioritization of navigation projects. *Rijkswaterstaat* is assigned to advise, prepare and implement these projects. Funding for projects comes from the treasurer and usually covers the entire cost of a project. In 1815 at the Conference of Vienna, it was decided that major waterways in the countries along the Rhine river had to be free of toll and obstacles. This agreement still stands and implies that users of waterways should not be charged for use of the system in any sense. The network that falls under the responsibility of *Rijkswaterstaat* is a mix of adapted rivers and artificial canals (Figure 4).

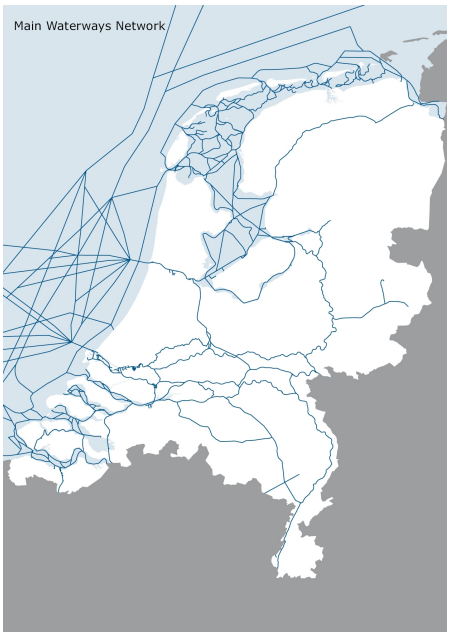

Figure 4 Main waterway network of the Netherlands (figure courtesy of Rijkswaterstaat)

Documentation provided a clear overview of the responsibilities of Rijkswaterstaat under the umbrella of the Ministry of Infrastructure and the environment. The Ministry has a broad array of responsibilities and each has its own internal line of decision making and funding. Transport policy and projects are evaluated and prioritized within the Directorate General of Mobility and Transport. User groups, which can also exert influence over representatives in Parliament, are consulted in this process.

A project's scope is agreed in cooperation between the local offices of *Rijkswaterstaat*, a central advisory unit from *Rijkswaterstaat* (*Dienst Water Verkeer en Leefomgeving*) and responsible officials at the Ministry. Local stakeholders are consulted early in the process. The actual project design results from an interactive process involving market parties (Lenferink, Tillema & Arts, 2013). As funding is earmarked for transportation purposes, there is only limited opportunity to provide for other requirements if these are costly. The legal project planning process includes informing and facilitating stakeholders in expressing their objections. Overall, waterway projects are agreed at a variety of arenas at national, regional and local levels. In appendix 2 an overview is provided of the main arenas and the rules determining the focus and value of waterway projects.

5 Analysis and discussion

The development of the waterway systems in two case studies, the USA and the Netherlands, has been studied through the lens of the IAD framework. The results will be discussed following the classical planning phases, from the 'agenda setting/policy level' to the local 'implementation level'.

Agenda setting/policy making
For both countries the rules of the action arena in this phase of planning appeared to be of a general nature. The arenas are the national parliaments where policy and investment plans are discussed, prioritized and allocated. The scope rules showed that the networks are considered a national issue, which seems logical as both watersheds and inland waterway transport cross many regional or local borders. To a large extent these rules determine what trade-offs can be debated, defended or decided on.

The scope rules also showed significant differences for both countries. A difference revealed by the data is that American plans cover waterway and port issues while Dutch plans cover national transportation and spatial development issues. A special '*sneller en beter*' (faster and better) programme has been implemented in the Netherlands to include stakeholder interests earlier in the process. Also in the Netherlands, a general policy has been adopted to stimulate public private partnerships, which provides opportunities for horizontal cooperation in the implementation phase.

In the Dutch situation the scope rules of the matters at stake include multiple modalities at the same time. Therefore trade-offs, interrelated and correlated issues can be part of the debate. In terms of pay-off rules the members of parliament can feel a priority for certain issues or modalities depending on their political preferences. For the USA this is quite different. Waterway issues are part of the US Army civil works plans, which is generally restricted to flood protection and navigation works. Other modalities like rail and highways are not part of it. The general policy for waterway investment, however, implies that local co-funding for each project is to be provided in the USA. This offers opportunities for inclusive approaches in the planning and implementation phase.

The pay-off rules are much more regionally oriented in the USA compared to the Dutch situation, as politicians have geographical confined constituents (boundary rules). Based on the scope rules one could expect, as the opportunity is there, an active integrated freight policy in the Netherlands in contrast to the American policy. However, the political preference in the Dutch situation has been a market oriented one; the policies do not favour any of the modalities above another. In addition, the nature of the networks does restrict such policies in some extend as the railroad network in the Netherlands is dominated by passenger traffic, whereas the waterways are mostly a freight system (table 2). In the US both systems are freight oriented, but decision-making takes place in different arenas.

Programming

In the Dutch situation the action arena for programming is the political decision making in parliament based on the plans as presented by the minister. In the American situation it is a double action arena. The data showed that the Inland Waterway Users Board plays a pivotal role in the US. The IWUB is a specialized stakeholder group of commercial waterway users. If the elected members of the IWUB reach unanimity (aggregation rules) on there advice to congress, congress will follow in most cases, otherwise congress would be action arena at play.

While Dutch plans cover a range of modalities including public transportation, American programming is much more narrowly restricted to the topic of waterways. In terms of pay-off the regional distribution plays a large role in American decision-making, while Dutch decision-making also includes distribution across (transportation) sectors and modalities. It was observed that wrapping multiple projects into programmes was regarded in the Netherlands as a method for optimizing beyond the individual projects; it widens the scope rules. Such an approach bridges the gap between programming and planning. In terms of the rules at play the boundary rules allow a much larger influence of the users of waterways in the American situation compared to the Dutch situation. Altogether the American arena for programming is very much aligned for sectoral optimization, while the Dutch arena offers ample opportunities for inclusive approaches.

Planning

It is in this phase that a variety of deals have to be made with local stakeholders, regulatory bodies, municipalities and other independent democratic entities. As expected, many ties to institutions, stakeholders and other organisations were found in both countries. The results showed for both that two main decisions determine the results at this phase of waterway development: a ‘regional agreement’ and an ‘approval by regulating authorities’. The regional agreement in the Dutch case was referred to as a ‘*bestuursovereenkomst*’. This *bestuursovereenkomst* is often a convenant among regional and local government bodies determining a project’s scope, mandate, funding and some regulatory issues. The approval by regulating authorities is called the ‘*planbesluit*’ and is a formal planning consent decision on the basis of the legal and environmental requirements for the project. In the US, similar roles were found for the Record of Decision (regional agreement) and the Environmental Impact Statement, including the mandatory documents and approvals from relevant government bodies. In both countries, the national authorities for waterways, *Rijkswaterstaat* and the US Army Corps of Engineers take the lead and possess the resources to negotiate the necessary deals, prepare plans and ensure approval is obtained in the permitting process. However, the American system is more dependent on local support as local co-funding is mandatory for federal approval. This is to ensure that regional stakeholders actually value the investment. In some situations this led to more inclusiveness, but it was also observed it led to a push for local contracting to serve the local businesses.

In general the data uncovered varying degrees of inclusiveness of function and value in projects in the two countries. The pay-off rules in both cases showed limited rewarding for an inclusive approach for both *Rijkswaterstaat* and the US Army Corps of Engineers. The strictly enforced remit of the US Army Corps of Engineers was often mentioned as restrictive. *Rijkswaterstaat* had a more relaxed attitude towards its remit. Despite this more relaxed attitude, the low pay-offs acted were considered as hurdles for further inclusiveness. In terms of obstacles and opportunities the data point to the problematic combination of these agencies' strict focus on navigation and the low pay-off for broader optimization.

Project preparation and implementation

The preparation and implementation phase involves a lot of local work to prepare a project, negotiate a variety of issues with local stakeholders, prepare the bidding process, contract a construction company and manage construction. The negotiations with local stakeholders and the contractual arrangement selected for project development can result in the yielding of greater or lesser value for the region. Project managers play both in the Netherlands and the US a pivotal role in decision-making. He or she is informed and advised, but the aggregation rules point out that this officer has a final say in many of the issues at stake. The pay-off rules, however, hardly reward this officer for action in order to increase the value of the project. On the contrary, the pay-off rules reward the project manager and his team to run a smooth and focussed project, avoiding complications where possible. This was found in both countries.

Also, a difference in approach came forward. It was found that *Rijkswaterstaat* typically passes design responsibilities on to the contracted parties while the US Corps of Engineers retains tighter control over these activities. Design responsibility for the contractor in the Netherlands was frequently mentioned as an opportunity for broader optimization. Reflecting this to the rules of the action arenas, it meant that the scope rules and aggregation rules provided less decision room for the Rijkswaterstaat project team to define the exact outcome of the project. Or, vice versa, the aggregation rules and scope rules provided the contractor and associated engineering team plenty of room to optimize to the project according to their insights. Nevertheless, little evidence was found of broader optimization beyond the scope of the assignment defined by Rijkswaterstaat. Optimization was often found in streamlining construction logistics and not so much in capturing related development opportunities. The data suggest that for the contractor and his design team the same reasoning is valid as for the client's team. Pay-offs steer in the direction of running a tight and efficient operation, not so much in the direction of exploring and capturing opportunities. Opportunities for wider optimization also need to be prepared in earlier phases of project development, phases where the contractor and his team played no role in.

6 Conclusions

In an era of rapid technological developments, waterway systems as transportation infrastructure receive little attention in literature. Nonetheless, a smart path towards redevelopment would be of value as many of these infrastructure assets are due for renewal. The high level of interconnection between

water and a wide spectrum of societal values requires broader optimization to maximize the social and economic benefit. As North (1990) stated: if institutions existed in a zero-transaction-cost world, the system would instantaneously react to changed preferences. However, when maximizing social and economic benefits, hurdles can be expected. This paper analyzes the relevant institutions for waterway development in the Netherlands and the US to understand where resistance is limiting value for society and where opportunities can be found for further optimization.

The IAD framework was selected as a tool to analyze the situation of waterways in development. The breakdown of the process into action arenas and the rules associated with these arenas proved to be helpful in understanding the decision making process. The American and Dutch systems were described on the basis of this framework. The arenas and associated rules are set out along the planning phases in infrastructure development: agenda setting/policy making, programming, and planning and implementation. In such way practitioners can easily translate the results into action for improvements.

The US and Dutch situations were found to be alike in many aspects, which is remarkable given the different planning traditions in these countries: the Anglo-Saxon and the Rhineland traditions. Both have a centralized system for managing and developing waterways, which is also found in many other western countries where waterways are of significant societal importance like for instance France, Germany and Austria. In the policy/agenda setting phase, decisions are taken about the outline of the waterway development. Project and investment priorities are determined in the programming phase, a phase that offers few opportunities for increasing inclusiveness. In both cases these two phases and the associated arenas are closely focused on efficient transportation solutions. Similarities were also identified further down the line, as the national waterway authorities, US Corps of Engineers and *Rijkswaterstaat* both play a dominant role at the planning and implementation level. These agencies negotiate with a variety of local and regional government bodies to determine the detailed scope and impact of waterway development. For both national authorities the scope rules were found to be restrictive in terms of broader optimization. Pay-off rules also seemed unhelpful, as there appeared to be no incentive for these agencies to work towards such broader optimization.

Aside from all similarities, also some fundamental differences between both countries were observed. In Dutch practice the policy-making and agenda setting is coordinated by a single ministry, which includes the entire transportation and water sector. Policy documents and decision making in parliament is therefore often framed in a broad way. However, as the current policy for transportation is market oriented, parliament is reluctant to intervene in market dynamics. Therefore, hardly any interconnected, integrated or active modal shift policies are pushed for. In other words: the Dutch context does offer greater opportunity for inclusive approaches at this level compared to the American situation, but it is reluctant to actually push for those approaches.

A second fundamental difference is the role of the waterway users, the transportation companies. In the American situation these acquired a formal role in programming through the IWUB. In the Dutch

situation the role of the users is much more informal. Nonetheless, programming of waterway projects in the USA means prioritising of a list of many urgent waterway projects in the context of a relatively restricted budget. One way or another, programming remains within the scope of waterway projects and the IWUB will assure the most urgent waterway transportation project will be prioritized. In the Dutch situation, programming encompasses the entire national infrastructure and spatial developments at once, and a less formal role of the user. Therefore much more flexibility trade-offs can be, and occasionally are, made.

A third difference was found in the mandatory local co-funding for the American situation, which was not encountered in such form in the Netherlands. This appeared to be a forceful incentive to engage local governmental bodies in the planning process. Valuable resources are at stake and results, which are appealing for their constituents, are desired. In some situations this led to more inclusiveness and capturing opportunities, in other cases a push for local contracting was observed to satisfy the local community.

A fourth significant difference is found in the implementation phase. In the Dutch context design responsibility is transferred to the contractor, the waterway authority contracts parties on the basis of functional requirements. In the USA the designs are made by the US Corps of Engineers themselves. Although potentially transferred design responsibilities could bring more opportunities for inclusiveness and broad optimization, the rules of the action arenas were not aligned to support the capturing of these opportunities.

In both cases the data showed well-developed and institutionalized vertical coordination structures and activities, clear examples are the hierarchic structures from ministries to the operational waterway agencies like the US Army Corps of engineers in the USA and Rijkswaterstaat in the Netherlands. Opportunities and incentives for horizontal coordination were found in both countries; however, the rules of the action arenas do not seem to be aligned in such way that opportunities are easily captured. Specifically in the planning and implementation phase, the lack of alignment of scope rules, aggregation rules and pay-off rules to support broader optimization is found to be a hindrance. Room for improvement is found in aligning these. The first signs of recognition of the narrow scope as a hindrance is observed in the Netherlands, programming now includes spatial projects in addition to infrastructure projects.

In the light of this study’s findings, waterways offer ample opportunities for broad optimization, serving society in many ways. Given the variety of policy statements underlining the importance of inclusive and integrated approaches, this is well recognized. Broad optimization, however, means acting beyond the vertically organized silos for transportation projects. It is important to recognize that the dynamics in these processes, where interests across scales and from different stakeholders come together, can be considered as multi-level governance. Acting beyond the vertically organized silos requires horizontal coordination with entities outside the hierarchical influence of the national bodies

responsible for waterway development. This can be, for instance, municipalities, provinces or private sector entities. For countries with waterway systems in need for reinvestment, application of mandatory co-funding, as found in the USA, could be a helpful tool in stimulating such horizontal coordination.

This study shows that countries with an ambition to realign their ageing waterway systems to current society should pay particular attention to the planning and implementation phase. It is in these phases where intentions are turned into solid results. The rules of the action arenas should be aligned with these intentions to be effective. Special emphasis should be laid on strengthening horizontal coordination and local pay-off approaches. Further analysis of the incentives and frictions in horizontal coordination, specifically at the planning and implementation level would therefore be helpful to shed more light on the hindrances and opportunities for maximizing social and economic value in waterway development.

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