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Do we need to rethink our waterways? Values of ageing waterways in current and future society

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Abstract

In the past canals were developed, and some rivers were heavily altered, driven by the need for good transportation infrastructure. Major investments were made in navigation locks, weirs and artificial embankments, and many of these assets are now reaching the end of their technical lifetime. Two pressing problems arise from this development: (1) major reinvestment is needed in order to maintain the transportation function of these waterways, and (2), it is not clear how the implementation of integrated water resource management can be brought into harmony with such reinvestment. This paper aims to illustrate the problems in capital-intensive parts of waterway systems, and argues for exploring value-driven solutions that rely on the inclusion of multiple values, thus solving both funding problems and stakeholder conflicts. It argues that transaction-cost theory could be a helpful tool in exploring such situations and, furthermore, that the focus on value in cooperative strategies is key to defining viable implementation strategies for waterway projects.

Key words: waterways, ageing assets, value creation, IWRM, transaction costs

1 Introduction

Waterways are navigable waters, such as rivers, canals and lakes. These waterways have often been altered or developed for transportation purposes. The purpose of navigation did not only alter the characteristics of waterways in the past, it will most probably persist in doing so in the future.

In river and watershed management, a widely advocated paradigm for management and development of rivers is Integrated Water Resources Management (IWRM), (Global Water Partnership, 2004; Mount & Bielak, 2011; UN Water and Global Water Partnership, 2007; United Nations, 2010; World Bank, 2009, 2010). However, in literature IWRM has been criticized for the lack of translation of theory to action on the ground (Biswas, 2004; Brugge van der & Rotmans, 2007; Butterworth, Warner, Moriarty, & Batchelor, 2010; Heath, 2010; Jeffrey & Gearey, 2006). In practise this leads to the following problematic issue:

- Based on the life expectancy of assets in inland waterway transport systems, and the reliance of the transport sector on these systems, a new wave of waterway infrastructure investments is expected (Ministry of Infrastructure and the Environment, 2012).
- Literature is unclear on how these major and long lasting investments are to be implemented taking into consideration the principles of IWRM.

Illustrative examples of these assets for navigation purposes are navigation locks, weirs or artificial bank protection like steel sheetpile lining. The modification of these structures, if circumstances change or if they need to serve other functions than foreseen during design, is generally very expensive if not technically impossible (Pahl-Wostl, Jeffrey, Isendahl, & Brugnach, 2010).

The situation is becoming all the more pressing as more and more assets reach the end of their technical, or functional, lifetime. Such assets must be replaced in order to maintain functionality. Typically investments in these assets are optimized in terms of economic efficiency and fit the ‘predict and control’ paradigm in terms of hierarchical narrow focus governance and power delivery of massive centralized infrastructure elements by single sources of design (Pahl-Wostl, 2007).

If issues of ageing are not adequately addressed, users may experience direct or indirect consequences. This phenomenon is not only true for waterway-related infrastructure. Ageing is likewise an important issue when it comes to the performance, maintenance and development of railways, roads and many other types of infrastructure (Rogers, et al., 2012). In general waterway infrastructure has a few distinctive differences compared to other transportation systems like rail and road networks:

- Assets usually have long lifecycles (sometimes exceeding 100 years)
- Problems are less visible (underwater)
- Assets are capital intensive and strongly linked to the surrounding area due to open water and groundwater
- The network serves multiple purposes
- The network is vulnerable to failure due to a lack of alternative routes.

A strategy commonly used by waterway authorities is to extend the use of these assets as long as technically possible. Figure 1 shows the prognoses of the end of lifetime of waterway structures for the Netherlands. The chart shows waterway-related assets that are the responsibility of the national government (Ministry of Infrastructure and the Environment, 2012).

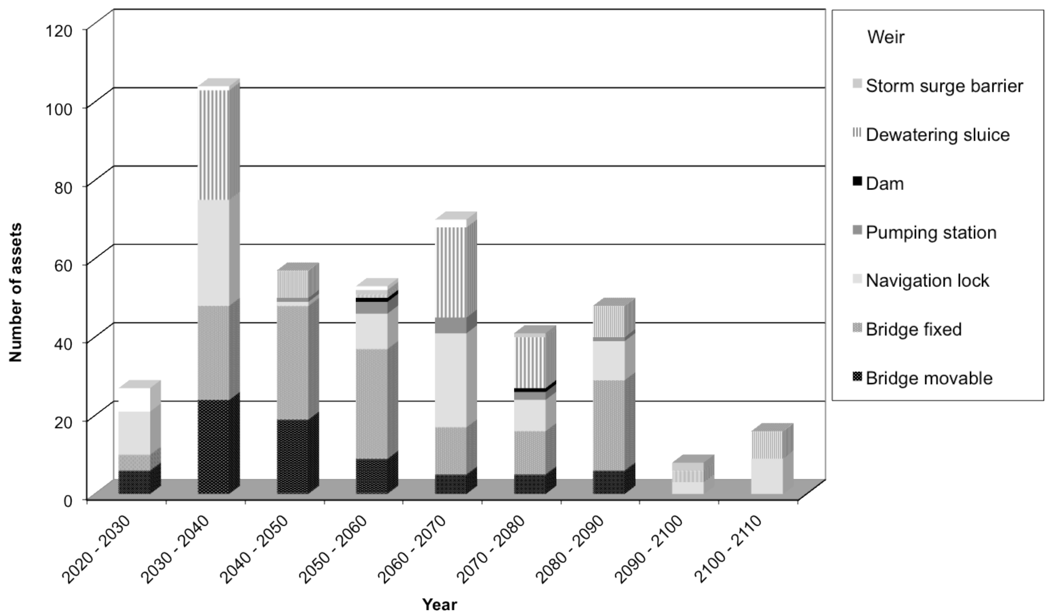

Fig 1: Projected replacement times for waterway-related assets of the Dutch national government. Replacement times are based on year of commissioning and technical lifetime of the assets (Ministry of Infrastructure and the Environment, 2012).

The figure shows that there will be a steep increase in the number of assets that will need replacing in the period from 2020 to 2040, given their design lifetime. Considering the significant preparation and implementation time required for these projects, timely planning is key. Preparations are currently being made for this in the form of national water strategies under the national Delta Programme and management strategies devised by Rijkswaterstaat (Ministry of Infrastructure and the Environment, 2012).

It is therefore important to develop a viable strategy to address the problematic state of these waterways. At the same time, the push for reinvestment can also be considered an opportunity to boost the meaning and relevance of these waterways for society.

Value is a key term in the search for a viable strategy and it plays an important role in the management of the assets themselves (asset management). The distribution of value among stakeholders determines whether these parties are interested in cooperating, co-investing, or competing. It therefore greatly influences stakeholder behaviour (IWRM).

A focus on value is far from new. The concept of Public Value Management, for example, has been introduced to the public infrastructure sector (E. R. Alexander, 2012; Stoker, 2006), but it is mainly used in the field of economics. Value often serves as the focal point for cooperative strategies or decisions to insource or outsources activities. Transaction cost theory is the widely applied analytical tool for unravelling the rationale behind value-focused decisions (Anand & Khanna, 2000; Coase, 1937, 1960; Parkhe, 1993; Williamson, 1981, 1998). Transaction cost theory, is about the set of frictions that determine whether such a decision or agreement is attractive.

This paper aims to find a viable strategy to address the tension between the transportation driven projected investments and the adoption of an integrated approach as advocated through the concept of

IWRM. In order to translate abstract concepts into implementable strategies it is necessary to focus on the value of waterways for society, the elements that these waterways comprise and the value of these for the stakeholders. It will be argued that a transaction-cost approach can help us understand the creation and distribution of value and the associated resistance.

2 Method

The emphasis on integrated waterway management, as well as on value, calls for attention to the rich and complex context of waterways. The paper is therefore based on a review of a database of institutional and physical characteristics of waterway projects (i.e. the Rijkswaterstaat database), which is then condensed into a constructed case that is written as a story. Stories are typically suited to such a purpose and can convey information in a compact form (Denning, 2005; Gargiulo, 2006). This method allowed the authors to visualize the problematic state of our waterways in an articulate way, and detail the dilemma of how to proceed with our ageing waterways. This example illustrates how value creation, making transactions, capturing and sharing value can drive an implementation strategy that fits contemporary waterway management concepts. The elements used in the case have been selected according to recurring characteristics in the Rijkswaterstaat database. A four-step approach is used to construct the case:

Step 1- From the database, projects were identified in which pursuing value of some sort played a significant role. Rijkswaterstaat is the Dutch agency responsible for the national highways, waterways and water system. The criterion of significance was that the project had to include uses other than navigation itself. Table 1 shows the projects, which have been used.

Table 1

Project	**Included value(s) other than navigation**
Maaswerken Project	Nature development, flood protection, mining of gravel and sand. Water supply through the Julianakanaal, recreation.
Twentekanaal enlargement	Improving Ecological quality of the embankments

New Lock at Eefde	Improved water management for both drainage and supply
Omlegging Den Bosch, 9 km of new canal	Wetlands, recreational values, aesthetics
Replacement of 7 locks at the Zuid-Willemsvaart	Water drainage, ecological quality
Third navigation lock Beatrixsluizen	Recreational and heritage values
Renovation and deepening of the Beatrixcanal	Improving ecological quality, recreation (slow-lane cycling paths)
Self Supporting River Systems (IJssel)	Biomass production at floodplains to recover costs of river management
Room for the River	Housing, aesthetics, ecology, flood protection and recreation.

In a desk study, the data were organized according to policy coordination, investment strategies for the projects themselves, the context of the project and ageing of the assets involved.

Step 2 –In-depth interviews were then conducted with the project managers of waterway projects to explore the value opportunities that had been identified and the difficulties in capitalizing on these opportunities. The interviewees were selected on the basis of discussions with practitioners in the field. If value creation amongst stakeholders had been successful or seemed possible, the responsible project manager was interviewed.

Step 3 – The ideas and data obtained in steps 1 and 2 were based on the experience of one organization. International valorization of these ideas and data took place in discussions with practitioners from the PIANC working group on values of waterways. PIANC, the Permanent International Association of Navigational Congresses, is a global organization providing guidance for sustainable waterborne transport infrastructure for ports and waterways. The waterway agencies of seven countries are represented in the PIANC working group: the Netherlands, USA, Egypt, France, Belgium, the United Kingdom and Germany. The meetings took place in Sept 2010, February 2011 and July 2011. During these sessions, six to eight workshop participants from different countries were asked about policy coordination, investment, context and the use of value in waterway projects with which they were familiar.

Step 4 – In the last step the illustrative case was created – a fictional story – which was based on the projects and the data and ideas gathered in the previous steps. As explained above, the elements were selected for the story according to generic characteristics from the database.

The section that follows describes the deeper background of ageing of navigation assets and the expected new investment wave. Then comes section 4, which provides the details of the case which is based on ageing of assets and provides both an ‘efficient asset management’ strategy and a ‘value driven’ strategy for redevelopment. In section 5 the case is discussed, and in the last section, section 6, the conclusions are drawn.

3 Theory

Replacing navigation assets takes place in a different context from the one in which most waterway assets were originally created. There were traditionally only limited dealings with stakeholders when canals were being developed or rivers altered to serve the transportation industry. Furthermore, the environmental or social effects that needed to be taken into consideration were relatively limited. Contemporary projects, however, need to take into account a multitude of stakeholders and effects. As water has always played an important role in the development of societies, the interests and effects that need to be taken into account are often as numerous as they are diverse. Table 2 lists functions typically related to waterways. It is based on the international experiences of the members of the PIANC working group on values of waterways and was used as a guideline for group discussions. The discussion revealed that the list is not exhaustive and it is difficult to attribute a clear outline to the selection. In this paper this list is used to give an impression of the complex relationship waterways can have with the surrounding area, institutions and stakeholders.

Table 2: Functions and values of waterways (non-exhaustive). Source; PIANC working group 139, 2010

Functions and values of waterways			
Cargo transport	Irrigation	Flood protection	Ecology

Hydropower	Cooling water	Drinking water	Industrial process water
Ecosystem services	Water storage	Administrative border	Water drainage
Historical/heritage	Social coherence	Cultural identity	Religious values
Recreation at embankments	Passenger traffic	Water recreation	Military purposes
Landscape/estaetics	Housing at or on the water	Fishing	

With this list in mind, and considering the interconnectedness of different functions and values, waterways have certainly become complex systems that cover social, environmental and economic areas. Complex systems are sensitive to this interconnectedness (Holling, 2001). Adapting these waterways to face the challenges of modern society is therefore more complex than finding a straightforward solution to a single issue (Axelrod, 2011).

Since the waterway networks were completed, there have been dramatic social, technological and environmental changes (Filarski, 2013). In the era of the transport revolution and network development (19^{th} century) the major part of the system came in place. In the 1930s a major investment surge adapted and improved the system. A second interesting reference point is the period from 1950 to 1970, when large scale improvements and modifications were made in order to align the characteristics of the waterways with the requirements of the time (Filarski & Mom, 2008). This entails not taking into account the vast majority of developments that have occurred since the 1970s and affected the major assets of the networks. It also means that the local situation determines whether developments dating back further are taken into account. Table 3 lists a selection of developments that were relevant to waterways using these time frames. A third column is added referring to a next investment surge due to required replacement of ageing assets.

Table 3: Two historic and one expected investment surges in waterway networks. Selection of relevant characteristics at the historic moments of investment in the Netherlands by Filarski and Mom (2008) and Filarski (2014). Characteristics at projected investment by authors.

Sector and society characteristics in early 19th century up to investment wave in the 1930s in Netherlands.	Sector and society characteristics in last major waterway investment period in the Netherlands (1950s to 1970s)	Sector and society characteristics in expected investment wave due to end of lifetime of many assets (present - to around 2040).
Navigation Transport by towing ships, diligence stage coaches, sailboats, horse and carriages Fine-mesh waterway network No open water dredging capability Rivers mostly in natural condition River and open water navigation unreliable due to weather conditions Canals provide reliability for transport Long-distance passenger travel mostly by water Shallow draft ships Emergence of steamships Society and waterways Widespread poverty Economy based on agriculture and crafts	Navigation Deteriorated condition of waterway network Technological capability to dredge rivers and open water Emergence of push convoys of up to six units Decline in number of commercial inland vessels Economies of scale in inland transportation Fully motorized fleet Disappearance of towing convoys Introduction of on-board IT equipment Improved manoeuvring capability of ships Containerization of general cargo Improvement of productivity and safety Society and waterways	Navigation Focus on multimodal or synchromodal transport Further growth of containerisation. Focus on fuel efficiency and emissions. Increased climate extremes Improved track, trace and travel planning. Further increase in recreational navigation Growth of average ship size as new vessels are mostly large, decommissioned vessels are mostly small. Society and waterways Climate change and adaptive measures to be taken around waterways. Sustainability, recycling,

Industrialization Limited influence of cost-benefit analysis in government decisions Mature railway networks Emerging influence of global competition Urbanization Growing competition from railway	Fast growing economy European seaport competition Railroad cargo transport no longer competitive with waterway transport Cost-benefit analysis for projects standard Small waterways obsolete for commercial use Emergence and growth of recreational navigation Importance of environmental issues Cultural heritage of waterways	and closing the material loop as a key concept in construction. Decarbonisation of transport. Integrated view on waterways by the general public and growing participation of public and/or stakeholders. Strict ecologic legislation to take into account in waterway development.

It is not possible to capture all relevant changes in society and the economy in a single table. However, the main question that arises is what this list actually means for the current situation and the desired future situation.

4 Story of the ‘Hoven Canal’ - value as a driving implementation strategy

This example helps identify a new infrastructure investment strategy that might bring substantial benefits to a wider range of stakeholders because it employs a more integrated approach towards waterway redevelopment. The story begins by discussing typical generic attributes of a Dutch waterway before continuing by demonstrating the difference between two emblematic management strategies: a more traditional specialized approach and a value-oriented approach to waterway management.

History of the canal

About a century ago, the town of Hoven faced several problems. Industry in the region was under severe pressure because the neighbouring town of Veld with its superior riverside location represented lower transportation costs. In addition, during periods of high rainfall, the farmland around Hoven was poorly drained, whereas in the summertime there was frequently a lack of sufficient irrigation water. Local politicians, in conjunction with industrial and agricultural leaders, launched a plan to improve the situation in Hoven. The key feature of their plan was to connect the region to the river with a new man-made, 40-kilometre-long canal (Fig.2). The canal would serve as a transportation corridor, a drainage canal in wet periods and an irrigation canal in times of drought. Construction started in the 1930s, creating work at a time of crisis and mass unemployment. The canal is suitable for CEMT class IV shipping, these are ships of 85m in length, 9.5m in width and have a maximum draught of 2.5 m. The width of the canal at water surface level was around 50m. The project included two sets of navigation locks, sluices (to allow the discharge of water into the river as needed) and pumping stations (to pump water from the river to the town of Hoven in times of water scarcity). One set was situated at the entrance to the river and the other halfway along the canal. The embankments of the canal were stabilized using rock. The canal served the region well without any significant physical changes for the eighty years that followed. Over the years cargo transportation has grown to an annual level of 15.000 ship passages, 6 million tons of cargo incl. 70.000 containers. These ships served a variety of industry, amongst these the farming community (fertilizer, agro products), a chemical plant (salt products and specialized chemicals), and a container terminal.

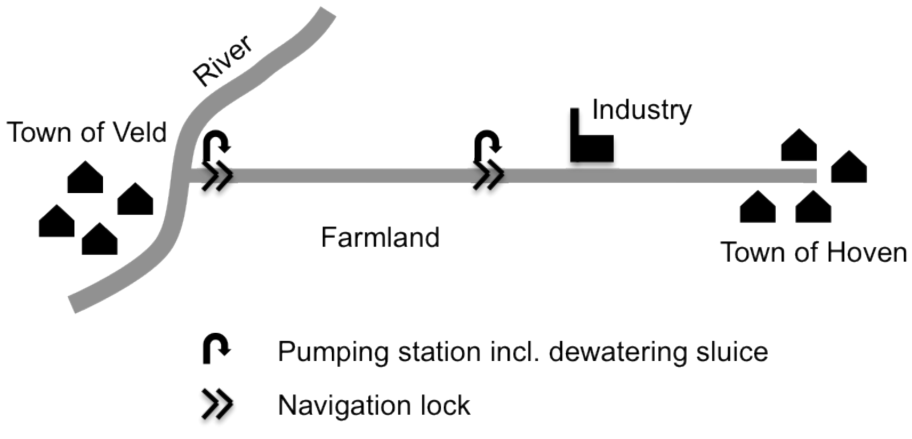

Fig 2: The Hoven Canal.

The end-of-lifetime dilemma – a traditional approach to artificial waterways

Around 2010, it became clear that the canal had reached the end of its technical and functional lifetime. The two navigation locks were no longer able to serve an increasing part of the country's commercial fleet as general ship dimensions kept growing. Typically in the Netherlands, many traditional local waterways have been dimensioned to CEMT class II (ship dimensions length, width, draught: 65m x 6.60m x 2.5m) or CEMT class IV ships (ship dimensions length, width, draught: 85m x 9.50m x 2.5m). Modern ships and nearly all of ships currently being build, however, are all of CEMT class V or larger (ship dimensions of length, width, draught: 110m x11.4m x 3.0m). Costs per tonne in inland navigation range from around € 5,- to € 20 euro depending no the ship size and distance of the trip. Container transport costs between € 170 and € 200 per TEU, again depending on ships size and distance. Critical ship dimensions are usually length and width as ship captains can choose to sail with limited cargo to allow them to sail shallow waterways. In the case of the Hoven canal, reliability of operations decreased to such a point that industry was no longer willing to use the canal. Furthermore, climatological change meant that the pumping capacity no longer met demand in times of severe drought. A study showed that the most beneficial scenario would involve rebuilding the navigation locks, sluices and pumping stations. This would not only bring the system up to current standards, but would also take into account new requirements for serving the modern fleet and changed rainfall patterns. The cost was estimated at €100 million: €40 million for each of the two locks and €10 million for each combination of pumping station and dewatering sluice. It was estimated that the new system would serve the community for 100 years. The result of a cost-benefit analysis was positive, and a careful Environmental Impact Assessment was undertaken. The cost of the proposed project included mitigation and compensating measures of various kinds such as replanting of trees, reduction of noise, vibrations and dust during construction. Generally these costs are very limited in the case of navigation lock renewal as the impact is very local and similar to the old situation (if this would have been a greenfield development the impact is generally much broader). Approval seemed a formality.

Questions destabilizing the traditional approach

The community raised critical questions. The calculations, it seems, were based on 30-year forecasts, but the new investment was supposed to cover a 100-year lifespan. How could that be? Some people wanted to know whether farming would still be important to the region in two or three decades' time. Others asked whether the industry that required increasingly large ships would still exist in 50 years, especially given the uncertainty caused by the economic crisis. Perhaps a focus on leisure, nature or cultural heritage would be a more appealing perspective for the region.

The decision-makers were unable to answer these and related questions with any certainty. How could they know whether the new canal would aid or prevent future opportunities that might yield a far more favourable cost-benefit ratio for the region? And, from an economic standpoint, the long-term development plan placed hardly any weight on radically different, but not unreasonable, assumptions about regional developments.

The alternative approach – a value-driven one

An alternative approach was consequently taken. Reducing the requirement of 2,5m draught for shipping to 2,0m created the possibility of a system with only one navigation lock instead of two. Vessels that are less heavily loaded but sail more frequently now serve the industry. Economies of scale in transportation reduce shipping cost per tonne, but are not necessarily optimal for the entire supply chain. Large shipments reduce some transportation cost per unit, but storage cost (dead capital) and the capital cost of unloading equipment rises as the size of the average load increases. However, the possibility of receiving large shipments can improve the negotiation power of the receiving firm.

There were also concerns about the reliability of the corridor. When storage is reduced, reliability of the supply becomes a concern. Industry therefore valued this aspect of the system. In order to enable this, the lock complex halfway along the canal was renewed, while the lock complex at the entrance to the river was removed in 2011. This was possible because the vessels' reduced draft meant that only a lock halfway along the canal was required and the one at the entrance of the canal could be removed. The reliability of the entire system doubled due to the removal of the one lock and renewal of the other. The operating and maintenance costs for the canal authority are now much lower than they used to be. Reduced economies of scale have been disadvantageous for transportation interests, but by reducing local port dues industry has been compensated.

In times of drought, water security for farmers is now more broadly framed. The issue of water supply was framed in the past as a farming issue. Over the last century, however, canal operations have become increasingly more important to a much wider group of users, whose concerns include household water, process water and cooling water. The water-dependent ecology also became a protected 'user' of the water. Given these developments, the demand for water over time is less straightforward. Restored wetlands connecting to the canal have increased the water storage capacity of the overall river system. For the canal authority it was important to align its ecosystem values with its efforts to increase water storage capacity and enhance the robustness of the water system. For the town of Hoven it was important to make the region a more attractive place in which to live or spend leisure time.

The pumping capacity was reduced because the system is far more capable of damping the extremes. This, in turn, lowered investment and maintenance costs while improving reliability (due to increased storage capability). 'Smart' irrigation methods have continued to reduce the demand for irrigation water.

In order to be able to implement all these changes, industry and farmers had to be convinced. Initially, the increased transportation costs made it hard to gain backing from industry. Furthermore, farmers were opposed due to the extra cost of investing in smart irrigation systems (to lower their demand for water). Both of these stakeholder groups initially preferred to keep their costs down by encouraging the canal authority to invest in the renewal of the 'old' infrastructure. But quick calculations revealed that the benefit would increase in the long term and the cost reductions would be far greater for everyone in the region. It was only those two groups who were facing short-term drawbacks. The question was therefore how to tap the long-term benefits to the region in such a way that they could be used to compensate those who would have to pay a significant price in the short-term.

Table 3: Summary of cost and benefits of the traditional approach and alternative approach the case study.

	Traditional approach		Alternative approach	
	Cost	Benefit	Cost	Benefit
Waterway authority	2 navigation locks (2 x €40 million), 2 combined pumping stations/dewatering sluices (2 x €10 million). Total €100 million.	None monetary. Addressing a policy goal, strengthening support for the agency.	1 navigation lock (€40 million) and 1 combined pumping station/dewatering sluice (€8 million). Total €48 million.	Reduction of operating and maintenance cost. Addressing a policy goal, strengthening support for the agency. Hydropower revenues. Reduced pumping cost due to smart irrigation by farmers. Reduced investment in pumping/dewatering station due to measures by municipality and farmers.
Industry	none	Economies of scale	Extra cost for transportation (less draught).	Reduced cost for handling and storage. Compensation by waterway authority for reduced available depth in canal. Increased reliability of transportation system
Farmers	none	none	Investment in smart irrigation equipment	Support by waterway authority from pumping cost savings. Less vulnerability at droughts.
Municipality	none	none	Development of wetlands	Support by the waterway authority due to reduced flood protection measures. Increased attractiveness of the region. Increased tax revenues through growing tourism and increased house prices.

5 Discussion

A question inherent to the case is whether the value-oriented management approach to the Hoven Canal produced a better outcome than the straightforward renewal of the old system would have done.

Although such a questions is difficult to answer entirely, the development of a more flexible approach to infrastructure investment and development does raise important issues. Decisions that respond to a broad spectrum of values are likely to have greater political legitimacy. The overall cost is lower, meaning that there will probably be less political opposition than otherwise.

The interviewees confirmed that, as in the story, for many waterways the ageing of the assets and the need for their replacement is what drives investment. The new assets need to meet two conditions: the multitude of stakeholder issues has to be addressed in some way, and the requirements have changed compared with the original ones.

In the new scenario devised for the Hoven Canal, a major break was made with the traditional approach by seeking value from issue linking. Whereas a single party can only optimize within its own boundaries, multiple actors can connect issues in terms of space, time or functions and employ, create or capture value by doing so (Evers & Susskind, 2009; Kabat, van Vierssen, Veraart, Vellinga, & Aerts, 2005; Susskind, 1999; Woltjer & Al, 2007). Multiple actors with either conflicting or parallel interests can seek mutual gain through their differences in utility, capability, expectations and forecasts or endowments (Lax, 1986). As the case shows, the alternative approach includes several transactions to harvest gains. A fundamental hindrance to employing these mutual gains is transaction costs (Coase, 1937; Williamson, 1998). Actors have to reach an agreement of some sort, which implies valuable, and for some actors very scarce, resources being deployed without any guarantee of reaching the agreement they would like.

With the Hoven Canal, by linking the problem of water quantity control to farmers and landowners for instance, more space was made available for a solution and the actors in the system did not act counterproductively because the incentives guided all actors in the same direction. This prevents one actor, the waterway authority in this case, being forced to make tremendous investments, which are, on an overall scale, far from efficient. Therefore, instead of basing investment on uncertain and unrestricted long-term demand forecasts (unrestricted because water users have no incentive to save water), investment on the both supply and demand sides needed to be optimized as a whole by linking the networks (Borgers & Van der Heijden, 2011).

A way then had to be found to compensate parties who were suffering loss. By making these links between systems, the overall reduction in the cost of improving the canal was around €50 million, and this was followed by permanent reductions in maintenance and operating costs. As the farmers and industry were facing, respectively, extra investment and higher transportation costs, part of the gain made by the Canal Authority was needed to compensate these stakeholders.

New functions of the system also contributed to the solution. Couplings in the case story include the enhanced aesthetic qualities resulting from the new embankments as well as the addition of wetlands (Thorp et al., 2010). A similar idea is being realized near the Dutch city of ‘s-Hertogenbosch, where a new nine–kilometre-long canal is currently under construction, which will be part of a wide ecological and recreational zone (Rijkswaterstaat, 2011). Around the city of Eindhoven the aesthetic qualities of the Beatrix Canal and adjacent wetlands have been rediscovered and are now being integrated into the recreational network around the city (Albers & Hendrikx, 2009).

Improved reliability is another factor that has been shown to increase the value of the system. The importance of this aspect of waterways has been recognized in the Netherlands, and a nationwide programme on ‘reliability of the waterways’ (Ministerie van Verkeer en Waterstaat, 2005) followed, which aims to improve this characteristic for the benefit of the users of the system. The interviewees stressed the importance of this aspect.

Different actors reaching an agreement achieved all the above-mentioned solutions. The interviewed project managers acknowledge that such an agreement could only be reached after considerable amounts of time, energy and money had been spent on the details, and yet the agreement involves different uncertainties than the actors have been used to cope with. These difficulties, referred to in economic literature as transaction costs, can easily obstruct the optimization process. As troublesome as transaction costs can be in the creation of value, however, there is a significant, albeit academic, upside to them. Transaction-cost theory has opened up an entire economic field of exploring and analysing optimization strategies for all sorts of organizations and has proven to be a fundamental element in organizations realizing mutual gains (Coase, 1937; Williamson, 1979, 1998). Transaction-cost analysis has found its way to other fields as well, including the interactions between public and private entities in the field of spatial planning (E. Alexander, 1992, 2001). The explanatory power of transaction cost theory when it comes to creating value could therefore be of great help in addressing the problematic state of our waterways with their need for high investment demand and multi-actor context.

6 Conclusions

The title of the article refers to whether we need to rethink our waterways. The answer is a clear 'yes' for countries where the ageing of assets entails a need for reinvestment and in which the socioeconomic environment has changed. These conditions apply to many western countries that rely on a properly functioning waterway system. The end of the functional or technical lifetime of many of the capital-intensive assets in waterways, such as navigation locks, weirs and artificial embankments, consequently creates a push for such a rethink.

The case study has shown that not all incentives to rethink the waterways arise from re-establishing the traditional function according to modern standards. Opportunities to enhance the significance of waterways for society are an important factor as well. As many waterways were traditionally developed with a narrow focus on navigation, there are opportunities to employ new values that are related to this system.

Current management practice falls short when it comes to developing these waterways to their full potential. Increasing awareness of this situation amongst practitioners could help move towards a more viable and efficient redevelopment path. The review of projects in this paper has shown that investment strategies for current waterway projects assume a broader consideration of both the physical and institutional context in which these projects operate. In particular, linkages (or couplings) between waterway values and other land-use values are imperative. A further assessment of the role of the transaction costs involved in integrating these values would be useful. Transaction-cost theory could be instrumental in revealing management strategies that are productive in employing value and generating alternative funding sources.

Finding value in cooperative strategies is a promising way forward for waterway authorities to find support and funding for those waterways that are in need of development or redevelopment. Applying a transaction-cost and transaction-benefit framework to the waterway sector could help gain an understanding of the possibilities and limitations of a value-driven strategy.

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