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Willems, J., Busscher, T., Woltjer, J. and Arts, J.

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Title: Co-creating value through renewing waterway networks: a transaction-cost perspective

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Authors: Jannes Willems, Tim Busscher, Johan Woltjer, Jos Arts

Abstract

Since modern waterway networks are increasingly confronted with ageing assets, waterway renewal will increase in importance for western countries. Renewal can be regarded an impetus for realising integrated waterway networks that internalise externalities, which entails broad stakeholder involvement. This can be coordinated through different inter-organisational structures. Applying a transaction-cost perspective, we contribute to the assessment of effective governance arrangements for renewing waterway networks in such an integrated fashion. Our aim is to examine efficient inter-organisational structures for waterway renewal, as perceived by actors involved in a case study of the Dutch waterways. Our findings show that waterway renewal incorporates additional functionalities in terms of capacity (expansion or reduction), but not so much in terms of quality (combining transportation aims with spatial objectives such as ecology or regional development). Inter-organisational structures that address geographical interrelatedness and, hence, broader stakeholder involvement were associated with uncertain and time-consuming transactions, because of extensive negotiations regarding the alignment of conflicting interests and the crossing of geographical and administrative boundaries. Also, a change in interdependency from hierarchical towards contractual relationships was required, putting dominant actors (the national government) in an unfamiliar position in which they loosen their grip on infrastructure investments. Perceptions on transactions centre on sectoral aims and individual assets, whereas the actual transaction may be different if a perspective is taken that includes the greater waterway system, the wider spatial surroundings and a longer-term horizon. We conclude that short-term, transportation objectives overrule longer-term, integrative objectives, which withholds strategic considerations required for aligning waterway interests.

Keywords: inland waterways; governance; stakeholder management; renewal; transaction cost economics; water management.

1. Introduction

Waterway networks are among the oldest as well as the most heavily used transportation systems. These networks are confronted with a major challenge: ageing assets. In the upcoming decades, vast investments are required to ensure the functionality (Gil & Beckman, 2009; IMF, 2014; OECD 2014a). A major number of these assets, such as weirs, bridges and navigation locks, were built in the course of the 20th Century and currently reach their technical end-of-life. Consequently, these have to be renovated, replaced or renewed, which introduces the need to reconsider existing functionalities of the ageing assets in regard to both capacity (reduction or expansion) and quality (removing or including supplementary objectives related for instance to recreation, ecology or regional development). Initially designed for demands back then, the renewal and renovation of infrastructure assets is considered a window of opportunity to upgrade waterway systems to current and future demands (Frantzeskaki & Loorbach, 2010).

Translating this opportunity into economic terms, renewal can become an impetus for a better use of waterway resources. Since the late 1990s, integrated forms of waterway planning have been proposed in which infrastructure investments are aimed at not only sectoral transportation objectives, but also additional societal goals (Notteboom & Winkelmanns, 2007; Hijdra et al., 2015). For instance, the creation of ecology-friendly river banks can benefit both the transportation and ecological function of a waterway. Accordingly, waterways have become multi-functional networks (Caris et al., 2014). There exists a wide array of integrated waterway planning approaches for coordinating renewal investments, which requires interactions between actors seen for instance in partnering, outsourcing or consulting stakeholders (Hijdra et al., 2014). Waterway renewal can therefore be considered an organisational question, in which infrastructure investments can contribute to aligning objectives and internalising externalities. In this conceptualisation, we consider redeveloping waterway networks as a form of voluntary collective action between different governmental bodies (and private actors) through the alignment or merger of interests that mutually profit both sides (Alexander, 1992). These actors are often highly dependent on each other, for example because of the location-specificity of waterway investments (Reve & Levitt, 1984). Shared waterway investments often involve long time horizons and extensive negotiations, in which actors cannot simply drop out as they will lose their investments made at particular sites. We can differentiate between transactions that include a broader geographical area and (hence) a wider array of stakeholders (aimed at internalising externalities), and transactions that centre purely on particular waterworks (leaving the externalities untouched). Recent research indicates that, in the face of waterway renewal, western planning practice is in search of suitable organisational forms (e.g., Malekpour et al., 2015; Roovers & Van Buuren, 2016; Willems et al., 2016).

For selecting the most efficient inter-organisational form, the transaction costs seem to be a determining factor. Transaction costs “can be seen as all the costs around a transaction other than the production costs” (Lai, 1994: 84). This includes, among other things, establishing relationships, gaining trust and enforcing agreements. Accordingly, “transaction cost economics explains how and why costs arise from the ways in which we organize to carry out

tasks” (Whittington, 2012: 272). In the domain of transport planning, this can be seen in, for example, research on the regulation of private involvement in infrastructure provisioning (Gil & Beckman, 2009; Soliño & Gago de Santos, 2010), the integration of services (Franc & Van Horst, 2010), and political processes surrounding transportation planning (Sager & Ravlum, 2005). Transaction cost economics thus offers a lens on the effectiveness of governance arrangements. Until now, limited research has been conducted on coordination forms for integrated waterway approaches that stakeholders consider efficient for the organisation of waterway renewal. Transaction cost economics research typically uses expert opinions to estimate *ex-ante* the types of transaction costs that can be expected and, subsequently, to categorise governance approaches (McCann et al., 2005). Based on these perceived transaction costs, (modifications of) inter-organisational structures are proposed to improve the alignment of interests. In extremes, this can result in either a hierarchy in which one public government is responsible for all waterway-related interests, or a market situation in which waterway-related organisations voluntarily undertake exchanges to their mutual benefit (cf. Coase, 1960). In practice, often hybrid forms of inter-organisational co-operation are established, such as partnerships or joint ventures (Williamson, 1999a; 2000).

This article aims to explore (i) the transaction costs that key stakeholders associate with different approaches for waterway renewal in order to internalise externalities and (ii) its implications for waterway planning by identifying risks and institutional barriers. To this end, we focus specifically on a case study of the mature Dutch national inland waterway network, in which the oldest assets date back to as far as the beginning of the 20th century. This case study was selected on the basis of its high information level. First, the Netherlands can be considered an international frontrunner with regards to waterway management (OECD, 2014b) and has started several large research programmes that explore innovative approaches for renewal. Second, waterways are of pivotal importance to the Netherlands, as a result of which a diverse set of renewal approaches can be expected. Our research question is: “*What transaction costs do key stakeholders associate with possible inter-organisational structures that address Dutch national waterway system renewal?*” This research will empirically contribute to the examination of feasible renewal approaches for waterway planning practice in the western world. Theoretically, applying transaction cost economics to the field of transportation helps to build understanding of why waterway investments for renewal are organised in specific ways.

The article is structured as follows: the second section discusses the theoretical framework in which transaction reasoning is explained further in relation to infrastructure investments. A framework is presented for analysing transaction dimensions to establish agreements for these investments. The third section introduces the case study and presents the methodology followed. The fourth, empirical section discusses and compares the transactions associated with three distinct approaches for waterway renewal. The article finishes with a conclusion.

2. A transaction-cost perspective on renewing waterway infrastructure

2.1. Co-creating societal value: towards integrative organisational structures

As a result of, among other things, decreased public funding, a growing competition for land and increased environmental awareness, public governments increasingly feel the pressure to generate more societal value from their infrastructure investments in waterways (Notteboom & Winkelmann, 2007). A wider involvement of other stakeholders may imply that governments have to move away from silo-based, hierarchically operating entities towards new organisation models in which multiple public and private parties can work together to their mutual benefit (Hijdra et al., 2014). For realising mutual gains, these parties have to look for potential combinations of goals to overcome differing, and sometimes conflicting, organisational aims.

In the field of transport planning (including port and inland waterway planning), new inter-organisational forms are being explored with broader stakeholder involvement, as seen, for instance, in increased public participation (Bickerstaff et al., 2002; Dooms et al., 2013), the development of integrated evaluation tools (Haezendonck, 2007; Woltjer et al., 2015) and integrated forms of transportation and land use (Hull, 2008; Caris et al., 2014). Although the functional interrelatedness is herewith acknowledged, parties often still operate in an institutionally fragmented context (Busscher et al., 2015; Heeres et al., 2016). As a result, the planning of waterways can be regarded a “complicated multi-scalar and multi-actor affair” (Romein et al., 2003: 207). This suggests that a wider geographical scope has to be taken into account and, consequently, more stakeholders need to be included – both those in the vicinity of the waterway and those further away.

Producing agreements between stakeholders for attracting greater societal value from waterway renewal investments can be seen as transactions and, consequently, will lead to parties making transaction costs (Williamson, 1975). Transaction costs are considered a determining factor in how stakeholder involvement is organised (Alexander, 1992; Whittington, 2012; Hijdra et al., 2014). Affected parties have to be brought together and produce agreements assigning property rights. This entails the establishment of relationships, which involves coordination, such as getting to know the other party, gaining trust, coming to an agreement and subsequently enforcing this (Buitelaar, 2003). Consequently, there are costs for carrying out a transaction in addition to the actual production costs, which can be expressed in monetary terms, but also in time, energy or efforts (Hazeu, 2000).

Transaction cost economics (TCE) is the academic discipline that explains how transactions are coordinated based on an economic theory of organisation (Williamson, 1975). Williamson (1975) posits that actors have a bounded rationality, so they will make decisions with incomplete information and asymmetrically distributed information (Parker & Hartley, 2003). TCE assumes that parties are self-interest seeking and aim for a lowering of transaction costs (Williamson, 2000). For that matter, they will behave opportunistically, strategically taking advantage of the information asymmetries. Contracts between actors can therefore never be optimal in practice. Although TCE is originally developed for understanding private firms, its concepts can also be applied to public bureaucracies (Moe, 1984; Alexander, 1992). According to Williamson (1999a: 319), “the absence of ideal markets in private sector transactions is precisely the opening through which TCE made its entry”. In other words,

private and public modes of organisation are often not “dramatically different” in practice (Moe, 1984: 760).

Analysing public infrastructure investments can benefit from insights of TCE, as these transactions contain a small number of involved parties and high asset specificity paves the way for opportunistic behaviour (cf. Williamson, 1975). Transactions that involve large, site-specific investments in assets result in bilateral dependencies (Reve & Levitt, 1984). This generally accumulates in hierarchical forms of organisation, so the risks of opportunistic behaviour are reduced through direct ownership and control (Williamson, 1975; Franc & Van Horst, 2010). For example, governments that have co-financed investments in waterworks at a particular place cannot simply “bail out” their investment and move it to another site without making large costs: to a high degree, they are interdependent (Alexander, 1992). In addition to asset specificity, the factors uncertainty and timing are considered key variables in explaining the form of organisation (Williamson, 1975; Alexander, 2001; Parker & Hartley, 2003), albeit empirically sometimes less prominent (Macher & Richman, 2008). Uncertainty refers to the extent future conditions (such as transport demands and regional developments) and human behaviour can be predicted; timing refers to the frequency and duration of transactions (the number of times a transaction is recurring). In general, it can be expected that renewal investments wider in geographical scope are accompanied with more uncertainties and demand more frequent interactions. For example, with the inclusion of more remote stakeholders, geographical and administrative boundaries have to be crossed which may generate additional transaction costs related to legal and authority-related issues (Rietveld & Vickerman, 2003; Lai, 2007).

The three dimensions of the transaction explain the established inter-organisational structures, also called “institutional arrangements” (Alexander, 1992; Williamson, 1999b; Buitelaar, 2003). TCE positions hierarchy and market on a continuum as the two extreme forms of organising leading to either hierarchical or contractual relationships (Coase, 1960; Williamson, 1975). Non-asset specific transactions will result in a market situation, in which production is completely decentralised by means of individual contracts between organisations. In idiosyncratic (highly asset-specific) transactions, sustaining the relationship becomes a concern because of bilateral dependencies (Parker & Hartley, 2003). This often includes elements of a hierarchy, i.e. an organisation that internalises additional activities within its own boundaries. As Williamson (2000) has argued, in practice, often hybrid forms prevail that include elements from both hierarchy and market. Applying this to the waterways, Hijdra et al. (2014) demonstrate that a wide-ranging set of inter-organisational structures can be considered for infrastructure investments that account for broader stakeholder involvement.

Table 1 provides a framework with the three variables (asset specificity, uncertainty and timing) that allows for a relative comparison of the transaction costs for renewal approaches that are different in geographical scale and stakeholder inclusion. Following Lai (2005: 9), we will not “measure transaction costs in a cardinal sense”, but “along an ordinal scale by ranking transaction costs of different institutional orders”. As such, we aim to understand expert opinions on transaction costs for each variable which can serve as “rough borders of magnitude” for comparing renewal approaches (McCann et al., 2005: 532). In other words,

following Buitelaar (2003), we are not necessarily looking for the costs of a single best approach that addresses externalities, but rather at what the differences in perceived transaction costs are when comparing different approaches. Ultimately, this exploration allows for identifying promising and less promising waterway renewal approaches.

	Explanation	Examples for waterways
Asset specificity	Degree of transaction-specific investments (related to location, technical equipment, and human capital)	Location-specific investments in infrastructure (weirs, locks) and plants (hydro-energy); financial investments in constructing equipment; knowledge of and experience in co-financing
Uncertainty	The extent future conditions and human behaviour can be predicted	Awareness of plans by other governments; mapping socio-economic trends; getting familiar with strategies by other actors
Timing	Duration and frequency of transaction: one-time versus recurring transactions	Consultation, disputes versus covenants, public-public partnerships

Table 1: The three dimensions of a transaction (adapted from Williamson, 1999a; Alexander, 2001).

3. Methodology

3.1. Introduction to the case study

We use a case study of the Dutch inland waterway network as an example to identify promising approaches for waterway renewal. Qualitative case studies are a common methodology in transaction cost economics (Shelanski & Klein, 1995). Our case study is based on informed selection, because it can be expected to have a high level of information content contributing to in-depth insights on the relatively recent issue of waterway renewal (cf. Flyvbjerg, 2006). Not only does the Netherlands have a well-established and well-documented waterway network (Lintsen, 2002), the country is also considered an international frontrunner in water management (OECD, 2014a). Moreover, the national government has made a €1.142 billion budget reservation until 2030 for waterway renewal investments (I&M, 2017). At the same time, it has started several exploratory studies to research novel waterway redevelopment approaches which include, for instance, innovative ideas for addressing current externalities in waterway configurations and incorporating a broader array of stakeholders (I&M, 2016; Van der Vlist et al., 2016).

The national inland waterway network is one of the oldest transportation systems in the Netherlands, with some assets dating back to as far as the early 1900s. The network consists of two main normalised natural rivers (Meuse, Rhine and their branches) and several man-made canals (such as the Amsterdam-Rhine Canal). The institutional setting surrounding the physical network has changed considerably in the previous century (Willems et al., 2016). As the Dutch constitution prescribes a central role for the national government in developing and protecting land, waterway provision is essentially considered a public task in the Netherlands, in which the Ministry of Infrastructure & the Environment takes the lead using public funding arrangements. Its executive agency Rijkswaterstaat in particular has been a powerful actor in

Dutch inland waterway planning and management (Lintsen, 2002). This agency designed and constructed most of the current assets in the waterways over the course of the 20th century. Despite the full national control in realising waterway infrastructure, local consultation is required by law, which leads to extensive consultation rounds.

Section 2 described a move towards more integrated forms of waterway development in which the national government has started to work more closely with, for instance, regional governments and port authorities (Dooms et al., 2013). As Hijdra et al. (2015) argue, transportation aims are increasingly connected to regional spatial developments, resulting in infrastructure that is more embedded in the local context. Consequently, the national government has become more dependent on other stakeholders for improving the allocation of waterways benefits across multiple users. On the one hand, authorities have incorporated more responsibilities by internalising new objectives related, for instance, to recreation and ecology. This marks a ‘modernisation’ of the settled hierarchy. On the other hand, authorities have established novel organisational structures to facilitate better coordination with other parties visible in joint contracts. Interestingly, this can be considered a move away from hierarchy, using more contractual rather than hierarchical relationships.

Currently, the public actors involved in the Dutch waterway network recognise the urgency to upgrade major parts of the inland waterway network (Van der Vlist et al., 2016). Multiple assets that were built in the early 20th century (in particular those from the 1920s and 1930s) are currently reaching their end-of-life-cycle. These assets include large-scale weirs, bridges, and navigation locks which are of national significance and are financed by national public funding. In order to integrate a broader set of stakeholder issues, the national government has drafted a new ‘Strategic Vision on Renewal & Renovation’ in which three renewal approaches are proposed that impact the alignment of interests (figure 1; I&M, 2016). First, the “1-to-1 renewal” approach entails the replacement of individual infrastructure assets executed one-by-one by the national government, in which the functionality remains untouched. The transaction is hierarchically (internally) organised, although local governments and waterway users (shippers) are consulted as required by law. Second, the “minor renewal” approach involves a change in functionality on the local scale, resulting in the involvement of a greater number of local stakeholders. Likewise, transactions with these parties may result in covenants in which the national government facilitates additional aims of regional and local parties. To illustrate, a municipality can contribute financially to the upgrading of a waterworks to include also a recreational bicycle path over the works. Third, the “major renewal” approach considers the replacement of specific assets as part of wider spatial, regional developments. Transactions, then, operate on a larger geographical scale with more distant stakeholders. For example, hydro-energy generated by weirs might be used by bordering municipalities that demand novel transactions. These transactions, which involve the co-financing of investments, can be captured in public-public partnerships. Altogether, the three approaches assign different roles for the strategically-operating Ministry of Infrastructure & the Environment, its operator Rijkswaterstaat, and regional and local parties.

[Insert figure 1]

Figure 1: Three approaches to renewal: (1) 1-to-1 renewal (internal transaction); (2) minor renewal (transactions with local stakeholders); and (3) major renewal (transactions with regional stakeholders) (cf. I&M, 2016).

3.2. *Data collection and analysis*

To explore which of the approaches are promising, we approached senior public and private officials operating in the inland waterway network and asked them to reflect on the three aforementioned renewal approaches. According to McCann et al. (2005), interviews can help in creating a first overview of implicit transaction costs, i.e. an overview of renewal approaches that interviewees consider either likely or unlikely. A total of 23 in-depth interviews were conducted, with interviewees working for, amongst others, the Dutch public authority Rijkswaterstaat, the Ministry of Infrastructure & the Environment, regional governments, interests groups, and knowledge platforms (see appendix A). The interviews aimed to reveal transaction cost-generating and cost-saving factors for the three variables interdependency, uncertainty, and timing (table 1).

The interviews were structured around three topics. First, we asked a number of questions focussing on the current institutional setting regarding the inland national waterway network. This included dominant actors and involved stakeholders, their goals, and their ways of working to achieve these goals. The second part of the interview concentrated on the renewal of infrastructure: do stated goals change because of renewal, and consequently will dominant ways of working also change? We asked interviewees about potential new stakeholders and new structures for working together. Specifically, we asked about risks and triggers for establishing new structures, in order to reveal transaction costs. In the third and final part of the interview, interviewees were asked to reflect on how the newly mentioned structures might be achieved by the sector as a whole. This part of the interview related to adjustments needed to start working differently, which could be either easily achievable through simple, incremental changes or more difficult, requiring vast institutional investments.

All 23 interviews, which ranged in length from 60 to 90 minutes, were audio-recorded and fully transcribed¹. The transcripts were systematically coded following a three-step-method:

- (i) Coding of the three renewal approaches: 1-to-1 renewal, minor renewal, major renewal (figure 1);
- (ii) Coding of the transaction dimensions for each approach: asset specificity, uncertainty, and timing (table 1);
- (iii) Coding of the perceptions of key stakeholders for each approach: Ministry of Infrastructure & the Environment, Rijkswaterstaat and regional governments (provinces).

¹ Two of the interviews were done by telephone and took only 30 minutes.

The use of the computer programme Atlas.ti supported the coding process. For example, codes for perceptions (step iii) were “responsibilities” (e.g. do interviewees consider the investment a shared concern or an internal task?), “finances” (e.g. what are promising partnerships or covenants?), and “stance” (e.g. do they mention risks or opportunities?). These codes were related to codes of the different parties and the three renewal approaches. As such, a matrix was created by which it is possible to identify expert views on potential transaction costs for each approach, as well as on the differences in perspectives across stakeholders.

4. Results: identifying transaction costs for renewing waterways

The three approaches as shown in figure 1 will be discussed in sections 4.1-4.3 based on the three variables asset specificity, uncertainty and timing (summarised in table 2). Section 4.4 consists of a discussion of the costs of each approach perceived by the three key stakeholders, allowing for a comparison between the three approaches (summarised in table 3).

4.1. 1-to-1 renewal: a technical affair

With 1-to-1 renewal, waterway assets are either replaced or renovated without altering their functionality. By doing this, the assumption is that externalities do not have to be addressed, as interviewee #19 argued: *“If I replace [an asset] 1-to-1, it implies that the [established] waterway system configuration will also function for the long term, that it is durable.”* This perspective follows a sectoral line of reasoning in which transportation and water safety purposes are key. To illustrate, interviewee #18 stated: *“I consider it [our task] to ensure that we protect its inland shipping function”*. The current waterways are already designed to ensure this, as a Ministry representative (interviewee #4) states: *“There have been waterways for a long time, the main routes are well-known. (...) Our targets have not changed much since 2012 [the launch of the national infrastructure vision], so in that sense [the waterways] operate very stably.”* This quote illustrates how the current allocation of resources is considered adequate, generally speaking.

For the variable asset specificity, it implies that the right of ownership, which is held by the Ministry of Infrastructure & the Environment, does not change. The Ministry commissions its executive agency Rijkswaterstaat to implement renewal measures to ensure the daily operation of the waterway system. Location-specific investments are thus internalised by the national government. The (internal) transaction is only complicated by the uncoupling of Rijkswaterstaat from the Ministry. On the one hand, Rijkswaterstaat holds detailed system knowledge on which the Ministry relies for its decisions. For instance, interviewee #8 states that *“the technical aspects of the waterways are the expertise and knowhow of Rijkswaterstaat.”* On the other hand, the Ministry brings in the financial resources without which Rijkswaterstaat cannot act. A Ministry representative (interviewee #5) argues that *“we obviously have a clear role, we also have the large sums of money, that is of course very arrogant to say, but [major investments] will not proceed without our involvement.”* Other

parties (private parties, local and regional governments) have a relatively weak position, as 1-to-1 renewal typically does not affect established property rights and the existing functionality remains intact. Consequently, they only have to be contacted through official consultation procedures and no transactions have to be agreed upon. Interviewee #15 working for Rijkswaterstaat explains: *“that is the more local stakeholder management [in Dutch: omgevingsmanagement] in which you only need to consult local parties if we go to work at a specific place in the country.”*

With regard to uncertainty, the transaction centres on getting the Ministry and Rijkswaterstaat on the same page in regard to the sectoral, transportation aims. Rijkswaterstaat is commissioned by the Ministry to deliver a technical state of the art of the waterway system every two years (RWS, 2017). Subsequently, the Ministry drafts a financial budgeting scheme and programme for the list of assets that need to be renewed to secure existing performance levels, which is reflected in the national Infrastructure Fund (annual budget for all national infrastructure projects) (I&M, 2017). According to interviewee #4, the two parties have different interests:

“Of course, Rijkswaterstaat looks after how you would like to have your waterway system in the practical operation, that beautiful navigation lock has to live up to all requirements, that is their role, fine. But obviously there will not be sufficient financial resources to cater for those wishes. We [the Ministry] are always challenging Rijkswaterstaat asking, ‘Is that all necessary? Where can we do a bit more, and where a bit less?’.”

To that purpose, mainly technical and financial information is transferred. This hints upon a national government which does not fear adverse selection, as it expects that other parties will not be harmed.

The timing of the transaction is seen in a longstanding relation between the Ministry and Rijkswaterstaat, in which both parties frequently meet. The client-contractor relationship has become formalised and institutionalised, with both sides familiar with each other’s responsibilities. To illustrate, interviewee #4 describes how the formation of Rijkswaterstaat as an executive agency in 2004 has resulted in a *“professionalisation”* of each other’s positions, in which responsibilities are harnessed and formalised in an administrative structure. This is far from political. Instead, it is more a bureaucratic, internal game to acquire the right funds for each asset to maintain current performance levels of the waterway network. As a result, the 1-to-1 renewal approach is an organisational form that is closely related to a hierarchy, in which the Ministry and Rijkswaterstaat have internalised their (sectoral) activities (figure 2; table 2).

[Insert figure 2]

Figure 2: Inter-organisational structures of: (1) 1-to-1 renewal (hierarchical relationships); (2) minor renewal (hierarchical relationships); and (3) major renewal (contractual relationships).

4.2. *Minor renewal: local stakeholder involvement*

Interviewees describe how, over time, they became aware of the limitations of the 1-to-1 renewal approach and the loss of mutual gains when this approach was continued. For instance, Rijkswaterstaat interviewee #14 states that *“there is a growing awareness that opportunities exist. Synergies. There might be regional problems for which we can create shared solutions.”* Likewise, the Ministry sees a potential for this: *“We want to trigger [Rijkswaterstaat] to look at their surroundings. Which developments do they observe when they look once more at their surroundings, or the waterway corridor? Is it possible to combine certain things?”* (interviewee #4). In addition to the sectoral aims of transportation and water safety, a new approach was developed that also more explicitly regards the integration of additional aims from neighbouring land owners. As a consequence, the externalities can be addressed through new transactions that incorporate additional functionalities. This approach is called minor renewal, in which the local context of the waterway asset is taken into perspective (figure 1).

At first sight, the asset specificity seems to increase, because more parties, such as regional and local stakeholders, make location-specific investments. For minor renewal, the Ministry obliges Rijkswaterstaat to deliver, complementary to a technical overview of waterway assets, a “regional consultation” (*regio-advies*) for each asset that needs to be renewed. Interviewee #21 explains:

“The regional consultation is meant not only to approach renewal from a budgeting and technical viewpoint, but also already in the earlier phases to look around, how does the asset relate to its surroundings? (...) Then its focus shifts to the engineering, the concrete and such, as well as to the consultation for programming and planning the asset integrated in its surroundings.”

Thus, concerning uncertainty, information on future waterway conditions becomes not only technical, but also functional (i.e. discussing other functions than solely transportation), as interviewee #15 explains further:

“The word ‘region’ was coined because it was seen as a sort of counterpart of the national technical overview. So the consultation ensures that for each region the operator Rijkswaterstaat starts in time to investigate more broadly with other parties in the area to explore the best synergies.”

This consultation moves beyond the common consultation, as more in-depth explorations with regional parties are started. Because of this growing information acquisition, it can be expected that adverse selection and moral hazards are likely to diminish compared to the 1-to-1 renewal approach. However, wider consultation is not necessarily required. The regional consultation obliges Rijkswaterstaat to inventory regional developments and identify potential synergies, in order to *“look past the blinkers”* (interviewee #16), but are not pushed to establish new transactions. Regional parties, thus, do not directly gain in importance, as

Rijkswaterstaat executes the exploration mainly by itself. The property rights and ownership of financial resources remain within the Ministry, just as the technical knowledge remains in the Rijkswaterstaat domain. The “minor renewal”-approach remains mainly a bilateral affair between the Ministry and Rijkswaterstaat. Inter-organisational structures in which, for example, regional governments co-finance integrated renewal projects are not considered. A Rijkswaterstaat interviewee #18 argues that often, regional developments have “*no infrastructural effects, at least not on the waterways*”. Similarly, interviewee #16 states that “*for the – say – seventy potential renewal projects, of which eventually twenty will proceed, perhaps only three will really need such regional consultation.*” This quote illustrates the limited advantages that Rijkswaterstaat interviewees in particular observe in incorporating also regional concerns. The timing of transactions, therefore, also remains largely the same. The Ministry-Rijkswaterstaat relationship is mainly deepened with the complementation of functional discussions. In sum, transactions remain an internal affair for the Ministry and Rijkswaterstaat, without much involvement of other parties (figure 2).

It must be noted that Rijkswaterstaat interviewees also argue that they do not have the mandate to start extensive consultation rounds with regional stakeholders, so they want to prevent high expectations. For example, interviewee #15 states:

“Formally, we need to have an order from the Ministry to start those sort of things. As Rijkswaterstaat, we cannot act independently. Look, we can independently contact regional stakeholders to ask, ‘what is your view on this?’. But as soon as we say, ‘we are thinking of renewing this particular navigation lock and what do you think of it?’, then it becomes complicated.”

The Ministry confirms that procedures for integrating broader regional developments in renewal procedures are still being tried out and developed. Interviewee #4 elaborates: “*There is a choice between two forms. Either you give a formal assignment with strict priorities to Rijkswaterstaat, or you continue with how we currently work, but you trigger [Rijkswaterstaat] to incorporate broader developments in another way.*” To conclude, the organisational form of minor renewal resembles the original hierarchy between Ministry and Rijkswaterstaat, in which the introduced regional consultation remains mainly an administrative feature which leaves property rights largely untouched (table 2). However, the interviewees indicate that the broader perspective deepens the information impactedness, seen in a growing interest in regional developments (dotted line, figure 2). To date, the national government tries to facilitate regional and local developments, but this does not accumulate into new transactions such as national-local partnerships.

4.3. *Major renewal: upgrading complete areas all at once*

The main reason why interviewees are hesitant to allocate more legal power to the regional consultation is that it comes close to the already legally established national programming, planning and budgeting (PPB) framework of key Dutch national infrastructure projects. This Multi-year Programme for Infrastructure, Land Use and Transport (in Dutch:

Meerjarenprogramma Infrastructuur, Ruimte en Transport; abbreviated to MIRT) has developed an extensive set of guidelines – “the MIRT-framework” – which help public governments to find common ground regarding infrastructure investments and, subsequently, develop shared partnerships and covenants per region, eventually leading to “MIRT-projects” (see Arts et al., 2016). According to interviewee #15, renewal projects can adhere to this framework “*once they are outside the domain of existing infrastructure*”, for instance because of expansion or a functional change. Renewal approaches in which the PPB-framework is used can be considered major renewal, as in this approach waterway renewal is perceived as an opportunity to upgrade complete corridors and/or areas in which national and regional parties collaborate (figure 1). As such, internalising externalities becomes an explicit aim.

The major renewal approach is associated with a different asset specificity. Instead of strictly divided location-specific investments, the major renewal approach produces location-specific investments that are shared between public governments (national Ministry and regional provinces) (figure 2). Consequently, sectoral aims are turned into more integrative, comprehensive aims. Interviewees from the provinces in particular argue in favour of the national programming, planning, budgeting framework. To illustrate, interviewee #7 states that renewal projects should always be executed using this framework to explicitly look for synergies with regional developments. In this setting, the technical system knowledge held by Rijkswaterstaat is complemented by expertise on regional development held especially by the province, which is backed by regional coalitions of enterprises, citizens and local NGOs. Furthermore, financial resources are not held solely by the Ministry, but supplemented by provinces and municipalities. For example, interviewee #8, who works for a province, argues that “*if you have certain [regional] ambitions, then you also have to take responsibility – also in financial terms.*” Altogether, the bilateral dependence increases, as functional knowledge of the waterway and surrounding land and the financial resources are better spread out among parties. As a result, transactions become more contractual and hazardous (figure 2).

In this approach, the uncertainty on future waterway conditions is quite high, as theoretically all sorts of objectives can be combined. To this end, the PPB-framework is an institutional arrangement that caters for biannual meetings between politicians of national and regional parties (*Bestuurlijk Overleg MIRT*) in which shared ambitions can be discussed. This prevents pure market-based relationships which are associated with high risks of adverse selection and moral hazards. In this framework, especially regional governments that present themselves as representatives of the region gain in power. For example, regional governments in the Amsterdam area have pushed the national government for the renewal and enlargement of the Sea Lock IJmuiden that links the port of Amsterdam to the world. A partnership between the national government, the province of North-Holland and the municipality of Amsterdam, leading to bilateral dependencies, resulted in a €3 billion project budget, to which the province and municipality contributed together roughly 33%. Interviewee #5 confirms:

“Provinces have become full-fledged stakeholders, because of the decentralisation [of spatial policies in the Netherlands since 2010]. (...) This implies that they think along and contribute financial resources if they want something. I observe that some provinces deal very well with that, compared to others.”

In contrast, Rijkswaterstaat loses power when compared to the other renewal approaches, as their technical expertise is no longer the central concern. Still, their technical expertise remains a trigger to start major renewal at all, so in that regard other parties still rely on Rijkswaterstaat. Interviewee #13 confirms: “*We are the technical expert, but we are not independent.*” Indeed, an operator’s interests are different from those of a regional government.

When using this approach, the timing changes significantly. The formation of partnerships between public governments leads to more, and more equal, contacts. Instead of consultation, regional parties now voluntarily co-operate with the national government. The duration and frequency of this interaction is established within the national programming, planning and budgeting framework. This framework involves for instance strategic-regional advisory groups in which public governments participate and that accumulate into explorations for specific infrastructure projects. In sum, the major renewal approach can be considered more of a contractual relationship between public bodies, moving away from the hierarchical organisational form (table 2).

	1-to-1 renewal	Minor renewal	Major renewal
Asset specificity	<ul style="list-style-type: none"> - Ministry has full control and financial resources, commissions its tasks to Rijkswaterstaat; - Rijkswaterstaat owns detailed technical system knowledge; - Other parties are heard through local and regional consultation. 	<ul style="list-style-type: none"> - Ministry has full control and financial resources, commissions its tasks to Rijkswaterstaat; - Rijkswaterstaat owns detailed technical system knowledge; - Other parties are heard through more extensive local and regional consultation. 	<ul style="list-style-type: none"> - Ministry and regional governments share right of ownership and financial resources, visible in contractual agreements (partnering) at particular locations; - Knowledge: functional (provinces, Ministry) and technical (RWS).
Uncertainty	<ul style="list-style-type: none"> - Technically-oriented, driven by engineers; - Sectoral focus on transportation. 	<ul style="list-style-type: none"> Technically-oriented knowledge is complemented with functional-regional developments through ‘regional consultation’ (without legal status): mainly mapping the interests, not partnering. 	<ul style="list-style-type: none"> High information level because of extensive discussions related to regional development, functionality of the waterway system.
Timing	<ul style="list-style-type: none"> - Formalised and hierarchical relationships between Ministry and Rijkswaterstaat; - Short and limited consultation with other parties. 	<ul style="list-style-type: none"> - Formalised and hierarchical relationships between Ministry and Rijkswaterstaat; - Short and limited consultation with other parties. 	<ul style="list-style-type: none"> - Specific moments in time to discuss each other’s interests, based on the MIRT-framework; - Outcome is the establishment of partnerships.

Table 2: Three approaches to renewal.

4.4. Comparing the transaction costs of the three approaches

This section discusses the transaction costs that interviewees relate to each of the three approaches, reasoned from the point of view of three key stakeholders: the strategically operating Ministry, its executive branch Rijkswaterstaat, and regional governments represented by the provinces (summarised in table 3 at the end of this section).

In the 1-to-1 renewal approach, the hierarchical relationships between the Ministry and Rijkswaterstaat result in “neat” transaction costs according to interviewees working for these two organisations. They argue that both parties have clear responsibilities and mandates, leading to efficient institutional arrangements. The interdependence is internalised, with the Ministry taking care of policy-making and budgeting and Rijkswaterstaat of the day-to-day-operation. Because of these responsibilities, the Ministry is the party that holds the financial resources and Rijkswaterstaat the party with the technical expertise of the waterway system. There is limited uncertainty as these asymmetries are overcome through fixed procedures and task divisions. Also, there are clear moments in time for interaction: internally in the division between the Ministry and Rijkswaterstaat and externally with other parties through consultation procedures.

Interviewees from all three groups give warning that the central potential transaction cost-generating factor is other parties’ ignorance in this hierarchical, sectoral approach. In the 1-to-1 renewal approach, the Ministry and Rijkswaterstaat operate as a silo-based entity with limited interactions with others. According to Rijkswaterstaat interviewees, their physical interventions in the waterway do not alter its functionality and, hence, other waterway users or surrounding land owners will not be harmed. As such, they perceive no need to invest in gaining knowledge of other parties’ perspectives. However, this can lead to a higher uncertainty (information asymmetries) which might generate transaction costs. The warning is not only uttered by the Ministry and the province (see 4.2); some Rijkswaterstaat interviewees also acknowledge the need to look broader to align interests with other parties. To illustrate, interviewee #17 states: *“The interdependencies are just a matter of fact, as a result of how multiple functions and areas are interwoven. [...] We cannot broaden a canal without talking to the municipality. That is not an option.”* This quote demonstrates how Rijkswaterstaat interviewees often take an instrumental viewpoint on collaboration, as a means to replace waterway assets efficiently. Discussing the current externalities is considered irrelevant. Yet, because they are not addressed, regional parties might object to proposals, because these proposals do not incorporate their objectives. Provinces argue that it can also benefit both parties. An example is given by interviewee #7:

“If we have to renew that weir, maybe we can create more integrative developments, like with a small marina or by building a hotel, in order to try and create more than just that sterile weir. It is also an opportunity to generate money in different ways.”

The minor renewal approach aims to overcome the sectoral angle by complementing the technical expertise of Rijkswaterstaat with a more functional overview of regional developments. The tool for this – the “regional consultation” implemented by Rijkswaterstaat – is new and still open to debate. Rijkswaterstaat interviewee #15 explains: *“We currently have not explicitly decided to actively approach and visit all sorts of stakeholders to ask what*

they think about it. But we have also not decided not to do so.” The Ministry, too, argues this tool is new to them: *“It still is new ground for us. I like to join a lot of discussions, but we hope Rijkswaterstaat knows what we think so we can leave it there.”* (#4) The provinces have not yet heard of the “regional consultation”, but argue that such a tool can be easily linked to existing regional organisational structures. For instance, interviewee #9 argues: *“Within the province, we have ‘regional tables’ where these kind of wishes can be inventoried, and where the likely development of a region can be discussed, not only infrastructure-wise.”*

As a consequence, so far, it is mainly Rijkswaterstaat that has to make more transaction costs by investing more in its regional partners. However, it does so mainly by solely inventorying regional developments through scanning regional plans and visions. Accordingly, the interdependence between parties remains largely the same (compare figure 2). The investment by Rijkswaterstaat is a transaction cost-saving factor for uncertainty, which will decrease to some degree as more functionally-related information is analysed, although this does not imply that new actions follow out of this. As also stated in section 4.2, there are only a small number of waterway assets that Rijkswaterstaat interviewees consider suitable for regional consultation.

The major renewal approach is based on contractual relationships between public governments, in which they voluntarily search for infrastructure investments that benefit all sides. Especially functions that relate to transportation aims are considered promising, such as commercial development along the waterways. Regional coalitions often identify a potential for stimulating regional economic development by upgrading waterways. To illustrate; *“We are located next to an international corridor, so how can we generate more economic growth to profit maximally from this together with our logistic partners?”* (interviewee #11). In that case, interviewees frequently point to the objective to achieve a modal shift from the road to waterway network: *“Companies like Samsung, Fuiji, Dell, Tesla, they have located themselves [in Noord-Brabant] partly because of the multimodal accessibility.”* (interviewee #8) Interviewees mention promising projects such as a widening of canals and allowing for new container terminals and related business sites close to the waterway. In regions where the national government perceives a reduction in future waterway use, provinces usually step in to keep waterways at existing performance levels for shipping. The province of Overijssel, for instance, has contributed € 1 million (50%) to the national government to ensure a 24/7 operation of navigation locks in the Twente Canal. The transportation interests resonate strongly with the initial aims of the waterway network, i.e. to bring prosperity by allowing transportation between towns in the Netherlands.

In addition to transportation aims, interviewees mention three clusters of aims that can be incorporated. First, environmental concerns have resulted in a focus on, for example, water quality issues (e.g., addressing salinization) and more eco-friendly canals (e.g., more natural river banks). Second, interviewees argue for making assets more sustainable in terms of construction materials. Also, assets could be used to generate renewable energy, for instance hydro-energy in weirs. Interviewee #18 explains that Rijkswaterstaat has *“the ambition to make all infrastructure assets energy neutral by 2020.”* Third, a reduced interest is put on connecting waterway assets with other types of users than just transporters, such as local

residents and tourists. In this perspective, assets can be perceived as heritage to not only attract tourists, but also to create a sense of belonging for local residents. These three groups of functions have been explored less, and seem to occur in a more ad-hoc fashion.

From a transaction-cost perspective, once more integrative aims are being looked for, interviewees argue that there is significant potential for saving transaction costs with major renewal as resources are better allocated. Successful examples can be derived from public-public partnerships in the adjacent fields of water management (*Hoogwaterbeschermingsprogramma*, *Ruimte voor de Rivier*, *Deltaprogramma*) and highways (MIRT-projects such as the A2 Maastricht), in which national transportation aims are combined with regional spatial developments. The contractual relationships in these partnerships monetise the value parties are willing to contribute, leading to an improved allocation of resources. The provinces and the Ministry in particular see the potential for such agreements. These partnerships are also said to legitimise budget allocations better, as more societal value is created out of initially “plain” renewal budgets. According to Rijkswaterstaat interviewee #13:

“You explore how the waterway configuration of [for example] the Meuse river will look live in hundred years. [...] That is a principal decision that is only dealt with by a limited number of experts. I thought by myself that ‘this simply cannot be true’.”

The Ministry also argues that more integrative perspectives are needed: *“It is very simple. I will not assign money for pure replacement [1-to-1 renewal]. Period. And as long as I do not commission Rijkswaterstaat, they will not receive any money.”* (interviewee #5) Parties, thus, have to start investing in each other up front, in order to familiarise themselves with each other’s interests. Accordingly, lower dispute costs can be expected.

At the same time, interviewees associate the major renewal approach with high transaction costs, because of extensive negotiations and alignment of interests. For instance, interviewee #12 states that *“for renewal, [the PPB-framework] is a heavy tool.”* It calls for longer time horizons in which parties co-operate and for more frequent gatherings between public governments. Rijkswaterstaat interviewees in particular caution to *“keep a firm footing”* (#16) in order to remain in control of waterway developments. This is driven by the responsibility of the implementer Rijkswaterstaat, in charge of the operation of the waterway network. Interviewee #18 warns that Rijkswaterstaat *“has to protect what is in place [i.e. the transportation function].”* The limited use of the major renewal approach in current practice seems to indicate that the cost-generating factors are perceived as higher than the cost-saving factors. Interviewees state that this approach brings in many risks to successfully get to an agreement to the mutual benefit of all parties and that benefits often remain intangible.

Comparing the three renewal approaches, we observe that transaction costs arise in each approach, but at different stages. Interviewees reason that the potential transaction costs in later stages in the 1-to-1 renewal approach are prevented in the major renewal approach, yet this approach comes with higher upfront costs. According to interviewee #17, these higher costs are legitimised because *“we [Rijkswaterstaat] cannot [replace assets] by ourselves, since waterways touch upon too many issues. It is a pure necessity to be more collaborative.”*

From this angle, wider stakeholder involvement is a means to protect the agency's own mission, as societal resistance can occur later on when infrastructure projects are planned and constructed. An economic driver exists for choosing the major renewal approach: it may lower transaction costs overall.

Nevertheless, an in-depth reconsideration of current externalities in the major renewal approach is only attempted once functional modifications do not harm the primary functions of the waterway network. This does imply a move away from responsibilities by the executive agency Rijkswaterstaat (cf. figure 2). Since this approach is not yet seen in practice, our findings point towards an already sufficient allocation of resources and use. They also reconfirm the vested interests of dominant actors, echoing the concept of path dependency (Notteboom et al., 2013). From the perspective of the operator, the contractual relationships proposed in the major renewal approach are considered as requiring too many uncertain investments. Altogether, new transactions mainly seem to reconfirm existing transactions. This suggests that current waterway configurations are not questioned, but rather taken for granted. This indicates an approach for renewal that favours established institutional structures and waterway configurations.

	1-to-1 renewal	Minor renewal	Major renewal
Ministry	Simple and comprehensible, but awareness of potentially missing out of opportunities.	Allocating responsibilities to Rijkswaterstaat; it knows our interests and ambitions, so we can leave it to them.	Promising and in line with new strategies and structures in adjacent fields (e.g. water management).
Rijkswaterstaat	Manageable, operator-oriented, feeling of being in charge.	Additional work with 'regional consultation' with unknown added value, and risk of increasing expectations.	Risky and uncertain inter-organisational structure; Only applicable to a few assets.
Regional governments (provinces)	Missing out of opportunities leading to objections; not looking for mutual benefits.	Minor renewal can easily be combined with existing regional collaborative structures that explore synergies.	Advantageous, because of becoming a more equal partner to the national government as a result of which mutual benefits can be jointly explored.

Table 3: Stances of the three key actors on renewal.

5. Conclusions

Modern waterways in the western world face a major challenge: the renewal of these mature infrastructure networks in order to meet current and future demands. Renewing assets can be considered an impetus to re-align and integrate the different functions that waterways can serve. To achieve this, different inter-organisational structures can be established that address the geographical implications of various waterway infrastructure choices differently. The aim of this article was to explore the transaction costs key actors associate with different approaches that address waterway renewal and the implications for waterway planning practice. We studied this specifically in the national inland waterway network of the Netherlands in which national infrastructure investments are predominantly a public concern.

Our empirical results demonstrate that waterway renewal is mainly approached as a possibility for incorporating additional functionalities in terms of capacity (expansion or reduction), but not so much in terms of quality (including functional-spatial objectives). As a result, renewal investments remain close to the initial transportation aims of the waterways and only limitedly account for the geographical implications and the involvement of other stakeholders. Although the actual transactions may be different in practice, interviewees perceive broader stakeholder involvement to imply uncertain and time-consuming transactions. Moreover, the asset specificity is expected to move from a ‘comfortable’ sectoral-driven hierarchy towards contractual relationships that aim to integrate different stakeholders and functions. Because investments at waterway locations become shared, dominant actors in the waterways argue that they have much to lose, and only little to win (table 3): interviewees perceive a negative trade-off between the additional transaction costs for broader stakeholder involvement, proposed in the major renewal approach in our case study, and the suggested benefits. This suggests that dominant actors perceive high institutional impediments to switch to other waterway configurations (cf. Notteboom et al., 2013). Path dependencies may thus result in “satisficing” actors that espouse to a bounded vision that subjectively may look efficient, but objectively may be far from it (Moe, 1984: 747). Actors do often not account for societal benefits, but rather optimise their own mandates. Ultimately, this results in waterway renewal investments that do not aim at internalise externalities, but rather leave them untouched. The dominance of the 1-to-1 renewal approach in our case study is a striking example, which was seen by interviewees as comprehensible and relatively straightforward.

Yet, our findings show how interviewees also consider the pitfalls of this approach. On the one hand, they are concerned about transaction costs appearing at a later stage due to legal disputes that might arise from not incorporating neighbouring waterway functions and demands. On the other hand, they see the potential for creating more societal benefits by combining different aims. Regional governments in our case study in particular stated the promise of more integrative approaches, in which their role will increase in importance. This approach does, however, require large upfront investments because of extensive negotiating and aligning interests, which indicates that emerging transaction costs in the later stages seem to be more accepted than those in the early stages (cf. McCann et al., 2005). Put differently, short-term objectives overrule longer-term objectives which withholds strategic considerations required for considering new waterway configurations. There are two reasons for this bounded perspective. First, regardless of the functional interrelatedness, we observed fragmentation among stakeholders, which makes parties unfamiliar with exploring new functions and the according required organisational structures. In our case study, we observe that active regional coalitions operate as a stimulus for the dominant national government to explore novel institutional arrangements. Second, organisational interests often prevail over societal ones: it is easier to stay within given mandates and administrative boundaries (cf. Lai, 2007). The focus is put on specific waterway assets, ignoring wider geographical and time scales in order to prevent shared location-specific investments and dependencies. Altogether, these findings suggest an institutional inertia that remains close to the current division of functions around the waterways.

Once the perceptions on efficient inter-organisational structures had been identified (table 2), our transaction-cost perspective reveals two major implications for transportation planning. First, dominant actors (the national government) are advised to invest in new inter-organisational structures which they currently consider as uncertain and risky. In that sense, these parties have to step out of their comfort zone, turning hierarchical relationships into more contractual ones that cater for the co-creation of societal value through integrative waterway planning approaches. This move implies a step away from the sectoral, asset-centred perspective. Second, other parties (regional governments and private parties such as energy companies) that gain in importance are suggested to take up parts of these newly created transaction costs, not only in financial terms but also in terms of human capital and expertise. This will result in a better distribution of responsibilities, costs and risks that may overcome the barriers that currently obstruct broader stakeholder involvement.

Our research has shown the institutional barriers of realising broad stakeholder involvement from the theoretical angle of transaction cost economics. Internalising externalities of infrastructure investments, as part of more integrative forms of waterway planning, will grow in importance, because of ongoing changing land-uses (e.g. urbanisation, climate change). As our study is a first exploration, future research can focus on a quantification of the transaction costs to substantiate these claims more, and, on a comparison of perceived costs with actual costs. Following Buitelaar (2004), we are aware that the transaction costs are just one out of many criteria for assessing infrastructure investments, albeit a critical one. Based on our research, we identify two other relevant research avenues. On the one hand, future research can explore the social benefits rather than the costs of more integrative approaches, because these emerging approaches suggest the seizing of opportunities by combining national and regional aims. On the other hand, integrative renewal approaches can also be examined from a legitimisation point of view, which is an important criterion for public bureaucracies (Moe, 1984). Future research can take up to what extent the growth in integrative renewal approaches can be explained by motives of regaining public authority.

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