

# Is Public Private Cooperation the Answer to Strategic Infrastructure Replacement in the Netherlands?

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## Abstract

At the dawn of a large infrastructure replacement program in the Netherlands the question rises whether current forms of public-private partnerships in infrastructure projects are sufficient to deal with the complexities involved in large scale replacement of water infrastructure objects. It is stated that the concept of public private cooperation is expected to be able to provide innovative and cost efficient solutions by means of smartly bundling expertise knowledge. Examination of case Stuwten Maas revealed that full cooperation, in the sense of client and contractors becoming equal partners, is not most efficient, however the relationship between public and private parties is strongly moving towards cooperation.

*Keywords:* Public – Private Cooperation; Infrastructure Replacement; Market Involvement; Public – Private Partnerships; Risk Management

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## 1. Introduction

Most of the water constructions in the Netherlands have been constructed between 1930 and 1950 in the Netherlands. These objects were designed for a lifetime of 80 – 100 years, hence reach the end of their technical lifetime in the decades to come. Decisions need to be made as to what to do with these assets<sup>1</sup> in order to prevent malfunctioning. As for Rijkswaterstaat, the infrastructure manager of 654 water construction works<sup>2</sup>, the expected required replacement investments can reach several hundreds of million euros a year. This covers a significant part of the total annual budget of approximately €5 billion, of which approximately €1 billion is meant for infrastructure construction and maintenance (Rijkswaterstaat, 2012).

The large replacement value is not the only factor that makes replacement of infrastructure assets important. Infrastructure assets share some characteristics that make replacement more difficult than infrastructure expansion. First, infrastructure objects are interconnected, which means that the performance and functioning of an object is dependent on the performance of other objects (Herder & Wijnia, 2012). Second, water infrastructure objects often fulfil multiple functions (Hijdra, Vlist, & Arts, 2014), which may change over time (Roovers & van Buuren, 2014). Third, the objects that reach their end-of life time have been over-engineered (Ackermans, 2015; Herder & Wijnia, 2012), while the

‘world around them’ has been changed. This creates an opportunity of change (redesign) of the functionality of the assets and the complete system. Assets are furthermore often designed for longer lifetimes, which mean that the replacement intervention may create a lock-in situation for the decades to come.<sup>3</sup>

At the dawn of the replacement challenge, Rijkswaterstaat as infrastructure management decision maker sees oneself placed for making crucial decisions that will have a great impact on the decades to come. The first decision is to determine what functions to prioritize (i.e. what to achieve with infrastructure). Subsequently it needs to be decided whether replacement is the right alternative for achieving this future performance. Finally, when decided to replace the design of the new system, assets and the role of these assets need to be determined. This decision will end up in a so called replacement strategy that describes the transition from the as-is situation to the future situation, including the replacement moment and sequence over time (DHV, 2010).

What these decisions indicate is that a pro-active approach to replacement may be beneficial, since only then the opportunity to change the system can be made.<sup>4</sup> To this extent, replacement provides an opportunity to replace cost efficiently and effectively. Hence, replacement is crucial for achievement of future goals. This is what makes replacement essentially different from extension. Crucial in this pro-active approach is dealing with future uncertainties, which come into expression in socio-economic and natural developments (Roovers & van Buuren, 2014). These will to a large extend determine the future ‘need’ and design space (Haasnoot, Kwakkel, Walker, & ter Maat, 2013).

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<sup>1</sup> Replacement is only one option out of many. Renovation, life expanding maintenance or removing the object are other alternatives. Also several replacement strategies are often possible. The decision to replace will be elaborated on in chapter 2.

<sup>2</sup> Of course not all 654 objects reach the end of their technical lifetime in the coming decades. The following numbers are expected: 25 (2020 – 2030); 102 (2030 – 2040); 55 (2040 – 2050) (Rijkswaterstaat, 2014)

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<sup>3</sup> Though the new objects do not necessarily have to be ‘static’ (this will be up to the designer of the new objects), the new system design will definitely create a new lock-in situation

<sup>4</sup> One-on-one replacement is of course always possible. A more ‘sophisticated’ replacement strategy requires a pro-active approach.

The replacement challenge is challenging for its new required approach to infrastructure management. The current situation in the Netherlands adds another level of complexity to that. Recent developments of decreasing infrastructure budgets, downsizing of Rijkswaterstaat and the political need for increasing market involvement, put the Dutch infrastructure system under pressure (van der Velde, Klatter, & Bakker, 2013; Wijnia & Herder, 2009) and force Rijkswaterstaat to rethink its role as infrastructure manager. Furthermore, Rijkswaterstaat has become more dependent on market knowledge due to downsizing of the organisation and the growing use of outsourcing. Recent debacles with large integrated contracts put pressure on the legitimacy of market involvement in infrastructure management (Houtekamer, 2015) and the public private role and responsibility division. Besides, Rijkswaterstaat is facing a 'market involvement dilemma'. Market involvement can potentially contribute to innovative, cost efficient and high quality solution's for replacing objects (Li & Akintoye, 2003), but these benefits will only materialize if market involvement is accompanied by a suitable governance mechanism (see Leendertse & Arts, 2013). Current available public-private arrangements are however mainly focussed on infrastructure projects. The context of replacement is more benefited by the use of a network approach. As such, both a new infrastructure management approach and a market approach are necessary for efficient strategic infrastructure replacement. Thereby it is essential to suit market involvement to the replacement context in order to prevent large cost overruns and delayed 'delivery'. It is therefore stated that the public-private role division should change. The focus of this article will be on the client-contractor relationship.<sup>5</sup>

Given the complexity of the replacement challenge at hand, less traditional forms of market involvement may be suitable or even necessary. The relation between government and parties is expected to change from a horizontal relation to a vertical relation.<sup>6</sup> However, current 'far reaching' initiatives of market involvement in the Netherlands, such as DBFM's and market consultation only relate to projects levels and still give the public client the majority of power (Leendertse, Lenferink, & Arts, 2012; Lenferink, Tillema, & Arts, 2014) and provide limited freedom for the market party to optimize outside of its project (Lenferink, Tillema, & Arts, 2013b), while this freedom for 'network optimization' is considered to be very valuable for the replacement context as described above. It can be (preliminary) stated that more equal client-contractor relationships with an 'open scope, result and goals' are considered to be more 'suitable' for strategic infrastructure replacement and as such contribute positively to innovation, quality and costs of replacement projects. The remaining part of this article will focus on examining this statement. Thereby this article aims to

contribute to the ongoing discussion on effective public-private task and role division in the public infrastructure sector. Section two will provide theoretical insights to guide the search for guidelines for public private interaction based on public private partnerships and public private cooperation literature. Next, the research approach will be explained in section three. Afterwards, the case study results will be presented. This article ends with discussion and reflection.

## 2. Theory

This section aims to give guidelines for a cooperative contractor-client relationship as indicated in literature. Also the client-contractor relationship will be operationalized to so called public private arrangements in order to be able to further investigate the added value of cooperation for strategic infrastructure replacement.

### The concept of public private cooperation

Initially, public private partnerships (PPPs) originated from a need to cooperate and to stimulate cooperation between government and private parties. The idea of public-private cooperation is that by means of cooperation both public and private parties can achieve objectives that could not have been achieved without the cooperation, which come into expression by the following requirements for successful cooperation (Dunn-Cavelty & Suter, 2009):

- a) The parties willing to start a cooperation should have complementary goals which are agreed upon;
- b) These goals can only be achieved by means of cooperation, such that all parties will benefit;
- c) The parties willing to participate in the cooperation should therefore be acknowledgeable to their mutual interdependencies before the actual cooperation starts.

What these initial conditions show is that before the actual public private cooperation starts, the participants should interact to discover common ground, formulate rules and norms for their cooperation (Schaeffer & Loveridge, 2002), discover and acknowledge their strengths and weaknesses and their contribution to the common goal. Also mutual trust should be created before fruitful cooperation can start and resources are to be 'freely' allocated (Adetola, Goulding, & Liyanage, 2011). The sharing of resources and exchange of information is an essential requirement for fruitful cooperation (W. Leendertse & Arts, 2013). This common ground should hence be the starting point for further cooperation and shaping of the project. Mutual trust can be created by close interaction between the parties (Dunn-Cavelty & Suter, 2009). This will also benefit the risk allocation and reward mechanisms and hence can contribute to creation of a positive relation between the risks that are taken and the risk premium and the alignment of responsibilities, risks and decision making authority (Becker & Patterson, 2005). The concept of early market involvement is a means to stimulate this early interaction.

<sup>5</sup> Even though the term contractor indicates a contractual setting, which is in turn a possible way of shaping the relation between public client and market party, the term contractor will be used to indicate a market party that is cooperating with the public client in order to achieve a common goal.

<sup>6</sup> Current research shows this trend in the infrastructure planning sector in the Netherlands (see for example Leendertse & Arts (2013); Leendertse et al., 2012; Lenferink, Leendertse, Arts, & Tillema, 2014; Lenferink et al., 2013a).

### Early market involvement

One way of ensuring that (potential) participants get to know each other, and each other interests and goals better is by means of early interaction (Zheng, Roehrich, & Lewis, 2008), also known as early (market) involvement, early private involvement (Koppenjan, 2005; W. Leendertse, Arts, & de Ridder, 2012) or early contractor involvement (van Valkenburg, Lenferink, Nijsten, & Arts, 2008).<sup>7</sup> This early interaction allows joint image building between client and contractor(s), such that they get to know each other's expectations before the actual cooperation starts and hence create a trust relationship (Koppenjan, 2005). Early market involvement is very useful for complex projects, since the risks and complexities cannot be managed and regulated by transactional types of agreements (contracts) (Lenferink, Tillema, & Arts, 2013a). Hence, early involvement is potentially useful for the strategic replacement of infrastructure.

A point of concern related to the early involvement is the power balance between public and private parties (Zheng et al., 2008). Trust relationships require equal or near equal power relationships, while the public-private 'relationship' is often characterised by 'power inequality'. This is not to say that public-private trust relationships are impossible to exist, but the public client always needs to be aware not to misuse its power to realize risk allocation and unilateral scope changes. From the client's perspective early involvement is not without danger. Given the limited number of 'early involved' contractors, competition may die out early in the process of infrastructure development (Lenferink, 2013), such that a so called private monopoly position exists (Kwak, YingYi, & Ibbs, 2009). This can trigger strategic behaviour, such as the 'freedom' the contractor has to determine the prices he imposes on the client.

### Operationalizing the public private relationship

Public-private arrangements are in essence public-private interactions.<sup>8</sup> Public-private interactions are shaped by governance mechanisms and strategies (Lenferink et al., 2013a). Hence, governance mechanisms and strategies can be used for describing public private arrangements. The following definition of governance will be used: "*coordination, steering and control mechanisms encompassing both structural and procedural elements*" (Koch & Buser, 2006, p. 551). This definition clearly shows that governance is used to ensure the achievement of a certain (common) goal, hence fits with the purpose of cooperation. Based on this governance definition the following elements can be used to operationalize the relationship between public and private parties:

#### *Relative initial power position client - contractor*

Power relates to the influence a party has to determine the purpose of the arrangement and the division of roles, tasks and responsibilities (Rufin & Rivera-Santos, 2012), hence resembles the

power at the beginning of the arrangement (initial power). The initial power division can resemble a hierarchical relationship, in which the client "*aims at a clearly defined common goal with explicitly formal structures and roles*" (Leendertse & Arts, 2013, p. 194). Furthermore, a relationship based on equality is possible, where equality relates to the joint formulation of goals, responsibilities, rights and duties, like is common in network governance structures (de Bruijn & ten Heuvelhof, 2008). A third possible value is a semi-hierarchical relation, which is characterized by the informal shaping of roles accompanied by formal rights and duties with regard to client-contractor interaction, such as evaluation moments.

#### *Contractor - client coordination and interaction*

Coordination exists of the alignment of activities towards the common goal, such that the joint efforts are made more effectively (Leendertse & Arts, 2013). The most 'intensive' form of cooperation consist of all participants jointly planning, coordinating and evaluating their efforts, and allocation of their resources to achieve the common goal (W. Leendertse & Arts, 2013). The same goes for interaction, which can be organized ad hoc or is formalized in a so called 'organizational arrangement' (Steijn, Klijn, & Edelenbos, 2011), for example a group of top representatives having regular meetings. Interaction and coordination can be frequently or infrequently arranged. Frequently means at least two times a year and at regular moments, while infrequently is less than two times a year and at irregular intervals.

#### *Degree of organizational fusion*

Client and contractor can stay strictly independent entities, or can 'merge' and share all of their organisational resources (Becker & Patterson, 2005; Love, Mistry, & Davis, 2010; Rufin & Rivera-Santos, 2012). Based on this, three values for this element can be defined: fully independent where the participants stay organizationally independent and decide themselves on the allocation of their resources and their contribution to the arrangement; independent (shared resources), where the participants jointly allocate their resources, place it in a different entity and jointly decide on the allocation; fully formalized, where all the organizational resources of the participants are allocated and all participants have joint decision making.

#### *Type of agreement*

In general two types of agreements can be distinguished: transactional and relational agreements. Transactional agreements are characterised by formal, static and strict agreements, based on control mechanisms, while relational agreements are informally arranged, which implies dynamic and flexible agreements based on information exchange and trust and aimed at high quality outcomes (Ling, Ke, Kumaraswamy, Asce, & Wang, 2013; Wettenhall, 2003; Zheng et al., 2008). Transactional contracts have a predefined and static scope, which are formulated by the client, while relational contracts offer a flexible or open-ended

<sup>7</sup> The term early involvement will be used in the remaining part of this report.

<sup>8</sup> This is what Leendertse (2015, p.7) calls a transaction: 'a set of relations (...) between infrastructure manager and market parties.'

scope, which is besides a product of interaction between client and contractor (Schaeffer & Loveridge, 2002).<sup>9</sup> Transactional contracts have a fixed duration, while relational contracts are fully or partly flexible.<sup>10</sup> Allocation of resources is formalized in transactional agreements, while being flexible in relational agreements.

#### *Reward & Resource allocation*

Rewards and resources can be allocated individually or shared, and can be limited or unlimited. Individually means that the allocation of rewards is defined for each agreement participant separately, in accordance with the investment, independent from the actual result of the arrangement (Schaeffer & Loveridge, 2002). ‘Shared’ means that the rewards for all partners are dependent on the result of the arrangement. An unlimited reward means that all parties share equally, limited means that up front the ‘reward’ share is determined. Table 1 provides an overview.

**Table 1** Types of rewards (based on Schaeffer & Loveridge, 2002)

	Individual rewards	Shared Reward
<b>Unlimited Reward</b>	Reward <i>independent</i> from result, equally shared	Reward dependent from result, equally shared
<b>Limited Reward</b>	Reward <i>independent</i> from result, <i>unequally</i> shared	Reward dependent from result, <i>unequally</i> shared

#### *Decision making distribution*

The decisions under consideration here relate to infrastructure management intervention decisions, such as decisions regarding maintenance, replacement, design and construction of infrastructure objects. The decision making distribution has three dimensions. The first is the degree to which decisions are dependent or independent: decisions are dependent when the decisions of one party influence and reinforces the decisions of other parties; independent decisions are decisions made in the own interest of the party, that are not in line with the joint interest (Schaeffer & Loveridge, 2002). The second dimension state that decisions can be fully coordinated or not (ibid). The differences between these are that in case of coordination the decisions are made with the aim to optimize the joint interest of all agreement partners (consensus for example), in its ideal form even leading to joint decision making (ibid). An ‘in between form’ is that decisions are negotiated and are competitive: next to the common interest, participants also try to maximize their own interest. Third dimension is egalitarian (equal authority distribution) or hierarchical (skewed authority distribution) (ibid). When combining these dimensions the following values appear: egalitarian, negotiated; egalitarian, coordinated; hierarchical, coordinated; hierarchical, negotiated.

Table 2 provides an overview of the element and their possible values.

#### **Hypothesis formulation**

The concepts of early market involvement and public private cooperation require a certain client – contract relation. Due to the characteristics of infrastructure replacement, it is expected that cooperation and early market involvement will positively contribute to the replacement outcomes, that is innovation, costs and quality. For each element value a hypothesis can be formulated.

*Hypothesis 1: The relative initial power position client – contractor will be equally arranged.*

Cooperation requires joint formulation of goals, scope and result, hence urging the need for equal public private power relation.

*Hypothesis 2: Contractor-client interaction & coordination will be informal and frequently arranged.*

Cooperation is based on trust and informal relationships, hence coordination will be informally arranged as much as possible.

*Hypothesis 3: Degree of organizational fusion will be independent, arranged with shared decision making on resources.*

Joint decision making and joint responsibility division require equal decision authority division between client and contractor(s). Therefore independent shared resources is expected to be chosen as element value.

*Hypothesis 4: A relational agreement will be opt for.*

The complexity of infrastructure replacement will require flexible, dynamic and informal arrangement, which have agreements formulated globally in order to jointly specify these further. Cooperation advocates these ‘open’ and flexible agreements in order for the participants to be able to ‘shape’ the project and responsibility such that these are optimally aligned with the skills and interest of the parties and as such deliver high quality performance. Scope, agreement duration, flexibility and formal resource allocation are all bundled in the concept of relational contracting.

*Hypothesis 5: Reward and resource allocation will be unlimited shared.*

The essence of cooperation is doing things together, which also means that all parties should equally benefit from cost savings, but also equally contributes to cost expenses.

*Hypothesis 6: Decision making distribution will be egalitarian and coordinated.*

Again, coordination and equal decision making is required to align interests and achieve the most added value.

<sup>9</sup> The scope concerns simply all infrastructure management activities, such as maintenance, replacement, design and construction, that are executed within the arrangement (Rufin & Rivera-Santos, 2012).

<sup>10</sup> A flexible duration indicates that the duration will be changed over time (during the cooperation itself) and may even be open-ended (infinite duration) (Aalstein, 2013).



**Table 2** Overview of client – contractor relationship operationalization

Element	Value 1	Value 2	Value 3	Value 4	Value 5
Relative initial power position client – contractor	Hierarchical	Semi-Hierarchical	Equal	n/a	n/a
Contractor-client interaction & coordination	No coordination and interaction	Informal infrequent	Informal frequent	Formal infrequent	Formal frequent
Degree of organizational fusion	Fully independent	Independent, shared resources	Fully merged	n/a	n/a
Type of agreement	Relational agreement	Transactional agreement	n/a	n/a	n/a
Degree of formal resource allocation	No formal allocation	Partly Formalized	Fully Formalized	n/a	n/a
Agreement Duration	Short (closed)	Short (medium optional)	Medium (long optional)	Long (+extension)	Open ended
Purpose	Limited specific	Limited broad	Open ended	n/a	n/a
Scope	Formally closed	Open ended		n/a	n/a
Flexibility	Non – flexible	Partly Flexible	Fully Flexible	n/a	n/a
Reward & Resource allocation	Limited individual	Limited shared	Unlimited shared	Unlimited individual	n/a
Decision making Distribution	Egalitarian, negotiated	Egalitarian, coordinated	Hierarchical, coordinated	Hierarchical, Negotiated	n/a

### 3. Research Approach

In order to determine to what extent public private cooperation is suitable for strategic infrastructure replacement, in the form of hypothesis testing, a case study approach will be used. The case study method is in general considered to be very suitable for testing hypothesis (Flyvbjerg, 2006). Context factors play an important role in both the ‘design’ of the client – contractor relationship and the effectiveness of this design (Koch & Buser, 2006; Koppenjan, 2005). Hence, a case study is a suitable research method since it allows to “investigates a contemporary phenomenon in depth and within its real-life context” (Yin, 2009, p. 18). Given the importance of a thorough examination of the research context and the limited time budget for the budget a single-case study was opted for.

In order to determine whether the hypothesis hold for application for strategic infrastructure replacement the case should resemble the characteristics of strategic infrastructure replacement as defined in the introduction:

1. The replacement moment is anticipated and covers a long time frame (>20 years).
2. Uncertainty plays an important role, both with regard to the replacement moment as regards what to put in place.
3. The size of the replacement is large, both financially and technically (covers multiple objects).

The case *Stuwen Maas* fulfils all these criteria and is therefore selected. The case is about 7 barrages located in the Meuse River, which have been built in the twenties and thirties of the twentieth century and reach their technical lifetime between 2030 and 2035 (table 3) (van Tilburg, 2015). The total replacement value is estimated to be €500 billion. Research to the ‘design’ of *Stuwen*

*Maas* has started in 2008 and is still ongoing. Hence this is widely known, reports have been written, and so data collection will be relatively easy. This makes this case very suitable for using in this research.

The concept of data triangulation advocates the use of multiple data sources in order to minimize the effect of chance and create an objective, rich and in depth view of the context and is especially important for single case studies (Verschuren & Doorewaard, 2010). For this purpose data is gathered both from interviews and documents. In order to create a balanced view, both respondents from public and private organizations were selected. The respondents have in depth knowledge of the case, and are therefore suitable to reflect on the public private arrangements designed. An overview of the respondent selection is to be found in Appendix A, the interview protocol is presented in Appendix B.

### 4. Case Stuwen Maas

#### Case Description

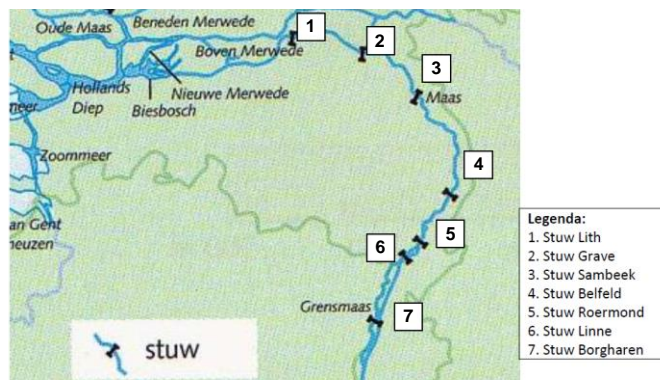
During the twenties and the thirties of the 20<sup>th</sup> century seven barrages have been built in The Maas River (figure 1). These barrages were designed for a technical lifetime of 80-100 years, mainly for the purpose to improve the navigability of the important trade route (Rijkswaterstaat, 2010). Now, almost a century has passed and the replacement moment lies ahead.

Since the construction of the barrages took place, much has changed. Inland shipping transport has increased, which lead to intensified usage of the barrages and sluices. Climate change has led to both increased need for regulating and maintaining water levels: higher water levels and longer periods of drought. The

main function of the barrages thus became more important. Over their lifetime the barrages have taken an essential role in their system. The water regulation function is for the Maas Region of great importance. Due to their long lifetime the barrages have taken a dominant position in the system and influence adjacent systems, i.e. their ‘environment’ and adjacent systems have been formed and developed while the barrages were in place. The barrages serve multiple purposes. Replacement will touch the interests of a wide variety of parties, which may have conflicting interests. Citizens will mainly care about local employment rates and the recreational and cultural value of the barrages, while Rijkswaterstaat is mainly concerned with providing a high quality trade route, with high draught and throughput capacity. The combination of ‘heavy’ inland shipping may interfere with the need of safe and pleasant recreational shipping. The large number of stakeholders involved might also provide opportunities for gaining additional support, the so called ‘replacement opportunities.’

**Table 3** Overview Characteristics Maas Barrages (de Jong, 2014; van Tilburg, 2015)

Barge	Year of construction	Planned replacement <sup>11</sup>	Replacement value <sup>12</sup>
Borgharen	1928	2025 – 2030	€52,2 billion
Linne	1921	2035 - 2040	€53,7 billion
Roermond	1921	2030 - 2035	€50,1 billion
Belfeld	1924	2030-2035	€50,6 billion
Sambeek	1925	2030-2035	€50,3 billion
Grave	1926	2030-2035	€67,3 billion
Lith	1936	2035-2040	€75,9 billion



**Figure 1** Locations of Maas Barrages (adapted from van Tilburg, 2015:4)

### Strategic decisions involved in replacement of the Maas Barrages

Given that the end of lifetime of the seven barrages falls within the same timeframe, the opportunity rises to ‘redesign’ the Maas network with regard to functionality and ‘focus’. The replacement

process can be structured in three ‘phases’. First, the future performance of the network needs to be determined, which is called a network alternative<sup>13</sup>: what do we want the Maas network to achieve? What functions and according performance to prefer? A few examples are to ‘focus’ the function of the Maas on flood protection, use the Maas as a ‘catalyst’ for the development of and upgrading of local mainports (for instance Venlo) to (inter)national mainports or use the Maas as a ‘field’ for alternative (green) power generation<sup>14</sup> (DHV, 2010). When the network alternative is chosen, the real ‘designing’ of the replacement can start by developing a so called replacement strategy. All activities undertaken to achieve the future situation from the as-is situation are part of the replacement strategy. For case Stuw Maas the replacement strategy involves making three decisions. First, the ‘role’ and functioning of objects need to be determined. That is, what ‘kind’ of objects are required, what should their performance and functions be, how many objects should be placed? This includes the design and construction of the new objects. Second, this new situation should be compared to the current situation: what does it imply for the barrages? Decisions need to be made as to what to do: renovation or replacement? Third, the management activities that are necessary to execute to arrive at the future situation need to be determined. This includes determining how to maintain the current barrages, deciding when to replace and deciding the replacement sequence.

### Added value of market parties

What can market parties contribute to the replacement process in this case? First, they can assist in developing the network alternatives. This task implies among others the identification and prioritization of stakeholder needs and forecasting of external factors. Second, market parties can design the replacement strategy, including (re)design of the new objects, choosing the replacement moment and sequence and manage the transition period from the ‘as-is-situation’ to the ‘after replacement situation’. The added value of market parties will lie in providing innovative and out-of-the box ideas and solutions, developing efficient replacement procedures and gaining efficiency by integrated management of the network.

### Client-contractor relationship

This section presents the results from the case study interviews, with regard to the client-contractor relationship.

#### Relative initial power position client – contractor

By showing the widest range of values among all elements this element could be considered to be the most controversial one. The

<sup>11</sup> Corresponds with the end of lifetime.

<sup>12</sup> Earlier estimates of the replacement value of Belfeld, Linne, Grave, Roermond and Borgharen barrages respectively reported Bn€154,5; Bn€181,2; Bn€, 101,1; Bn€154,5; €163,1 (Rijkswaterstaat, 2011).

<sup>13</sup> Of course it is also possible to replace ‘one-on-one’, whereby for each barge the functionality may change, but this change will be rather limited. When opting for a more innovative alternative, that is ‘redesign’ of the Maas network, one have to keep in mind that this might take a while, for a variety of studies will have to be executed, new functionality will have be ‘negotiated’ with stakeholders etc. It will be interesting to investigate and design this process from a process management perspective.

<sup>14</sup> For a detailed description and explanation see DHV (2010).

added value of equality for cooperation is emphasized and should be used as much as possible, however other respondents indicated that in case the cooperation does not work out as beneficially expected, or the contractor reveals strategic behaviour the client should be able to intervene hierarchically.

#### *Contractor – client interaction and coordination*

All respondents acknowledge the need for coordination and interaction between client and contractor during all stages of the replacement process. At the very beginning, coordination and interaction contributes to proper risk identification, division of tasks and responsibilities, and identification of each other competences (transfer of knowledge) (Michon, 2015). During the execution of the project itself to stay on track, to evaluate performance, to stay in touch, and to adjust or sharpen the responsibility and task division (Michon, 2015). For this reason formal, frequent interaction is preferred.

#### *Type of agreement*

The preference for flexible, dynamic and long term agreements is clearly expressed in order to stimulate innovation. That is not to say complete open agreements are preferred, some degree of ‘formality’ is required in order to have a solid starting point. However, the possibility to adapt scope, result and agreement duration should always be available, partly because of the long time horizon involved and the development of external factors (water heights, development of asset performance) is hence difficult to determine.

#### *Reward & Resource allocation*

Despite the best intentions to cooperate, cost savings and cost overruns should not be completely shared. Especially in case the contractor underperforms he should pay the extra costs himself. In case of cost savings however the client would like to share in this.

#### *Decision making distribution*

Intervention decisions should be coordinated as much as possible and client and contractor should have an equal power distribution. This means for example that the design of the new objects and the replacement moments should be agreed upon by client and contractor.

Table 4 provides an overview of the preferred arrangement values.

## 5. Discussion

Results from the case study show mixed preferences. None of the hypothesis is unanimously accepted, however four out of seven hypotheses can be confirmed based on the criteria ‘highest preference frequency’. An equal client contractor relationship is preferred, however not completely accepted, since initial scope and result setting by the client is considered to be an essential starting point for the cooperation to start and to prevent strategic behaviour of the contractor(s). The same goes for interaction and coordination, which is still preferred to be formally arranged. This is not in line with the expectations of cooperation. However, the preference for joint decision making of allocation of resources indicates the preference for cooperation.

**Table 4** Element value results (n=6)

Element*	Value 1	Value 2	Value 3	Value 4	Value 5
Relative initial power position client – contractor	Hierarchical(1)	Semi-Hierarchical(3)	<b>Equal (4)</b>	n/a	
Contractor-client interaction & coordination	No coordination and interaction (0)	Informal infrequent (0)	Informal frequent(2)	Formal infrequent (2)	<b>Formal frequent (5)</b>
Degree of organizational fusion	Fully independent (2)	<b>Independent, shared resources (4)</b>	Fully merged (0)	n/a	n/a
Type of agreement	<b>Relational agreement (6)</b>	Transactional agreement (0)		n/a	n/a
Degree of formal resource allocation	No formal allocation (0)	<b>Partly Formalized (4)</b>	Fully Formalized (2)	n/a	n/a
Agreement Duration	Short (closed) (0)	Short (medium optional) (2)	Medium (long optional) (1)	<b>Long (+extension) (3)</b>	Open ended (1)
Purpose	Limited specific (0)	<b>Limited broad (5)</b>	Open ended (1)	n/a	n/a
Scope	Formally closed (1)	<b>(Partly) Open ended (5)</b>		n/a	n/a
Flexibility	Non – flexible (0)	<b>Partly Flexible (4)</b>	Fully Flexible (2)	n/a	n/a
Reward & Resource allocation	Limited individual (0)	Limited shared (0)	Unlimited shared (2)	<b>Unlimited individual (4)</b>	n/a
Decision making Distribution	Egalitarian, negotiated (0)	<b>Egalitarian, coordinated (5)</b>	Hierarchical, coordinated (3)	Hierarchical, Negotiated (0)	n/a

*Note.* \* For some values the element frequencies are more than the number of respondents, since some respondents preferred two element values. Blue cells indicate hypothesis value; bold fonts indicated most preferred value.

Informal, relational agreements are generally considered to be of added value in order to benefit from the complementary skills of both client and contractor, however a certain degree of formality is considered to even enhance this.

The contractors generally favour longer agreement duration as this will stimulate innovation as a result of higher likelihood of returning initial investments. The client would like to have 'emergency procedures' formally arranged, as well as the performance targets the contractors have to achieve. In case of a severely underperforming contractor, the client should be in the position to 'fire' the contractor. Finally, both contractor and client would like to see especially themselves benefit from their own cost saving efforts, and are hesitant to pay for the cost overruns the other party caused. However, deciding on major intervention activities to undertake, such as establishment of the final designs of the new assets should be agreed upon by both contractor and client, even if the responsibility is given to one party.

## 5.2. Reflection and suggestions for further research

This research presents a first investigation on the opportunity for public-private cooperation for strategic infrastructure replacement in the Netherlands. Since only one case study has been examined, and only a limited number of respondents have been involved, the results of this research have to be taken with prudence.<sup>15</sup> Nevertheless, the results indicate a shift from traditional forms of market involvement, mostly focused on a dominant role of the public client, towards more equal relationships in which the client becomes a cooperation partner. Further research is needed to both 'deepen' the opportunities for public private cooperation and to generalize the results of this study. Also more research needs to be executed in order to determine the relation between the element values and project outcomes. Statistical methods may be of help here.

## 6. Conclusion

On the one hand cooperation is considered to be beneficial for efficient replacement of strategic infrastructure replacement, however not at all costs. The client should still have the opportunity to intervene hierarchically. Agreements with regard to scope, the agreement duration and should give both parties the freedom to determine efficient allocation of tasks, resources, tough general guidelines have to be set by the client. Hence, we can conclude that the shift towards cooperation is taking place, however real cooperation is not likely to occur. Differences between public client and contractors are still too big to make the step to full cooperation. Trust comes slowly, however fades quickly.

## Acknowledgement

The author would like to thank all respondents for participating in this research.

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<sup>15</sup> This does not per definition mean that these case studies are not generalizable (see Flyvbjerg ,2006).



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## Appendix A: Respondent selection

**Table A1.1** Overview of respondent selection case study interviews

Interviewee	Organisation	Public	Private	Independent	'Level'			Area of Expertise	
					S	T	O	PPS/C	AM
H. Michon	Rijkswaterstaat	✓				✓	✓	✓	✓
W. van Hengel	Rijkswaterstaat	✓			✓	✓			✓
M. Albrecht	Rijkswaterstaat	✓			✓	✓			✓
S. van Vuren	HKV		✓		✓	✓	✓	✓	✓
G. De Jong	Heijmans		✓			✓	✓	✓	✓
E. Waltje	Antea Group		✓		✓				✓

*Note.* S = Strategic; T = Tactical; O = Operational; PPS/C = Public Private Partnership / Cooperation; AM = Asset Management

## Appendix B: Interview Protocol (Dutch)

1. Hoeveel partijen moeten betrokken zijn bij het beheer van het netwerk?
  - a. Hoeveel marktpartijen?
  - b. Moeten de stakeholders (& lokale beheerders) opgenomen worden in het arrangement zelf?
1. Hoe moet de relatie tussen opdrachtgever en opdrachtnemer zijn? (hierarchisch / gelijkwaardige machtspositie?)
2. Hoe moet coördinatie en interactie tussen opdrachtgever en opdrachtnemer geregeld zijn?
  - a. Informeel frequent,
  - b. formeel infrequent
  - c. formeel frequent?
3. Hoe moet de organisatorische scheiding publiek en private partijen zijn?
  - a. Volledig onafhankelijk
  - b. Onafhankelijk maar met gedeelde resources
4. Hoe formeel dient de overeenkomst zijn?
  - a. Geen overeenkomst / Informeel (relational) / formeel (contractueel)
  - b. Formele (omschreven) toewijzing van resources = volledig vastgelegd.
5. In welke mate dienen de volgende zaken vast te staan aan het begin van de overeenkomst en als ze vast staan, hoe lang moeten ze dan duren?
  - a. Het product / dienst (resultaat)? (=purpose)
  - b. De duur van de overeenkomst?
  - c. Opbrengsten / kostenverdeling?
6. Hoe flexibel moet de overeenkomst zijn: de gemaakte afspraken in het begin, aanpasbaar tijdens de duur van de samenwerking?
7. Hoe moet de verhouding tussen inleg en opbrengsten tussen publiek en privaat zijn?
  - a. Opbrengsten/inkomsten afhankelijk van resultaat?
  - b. Gelijkwaardig verdeeld of niet?
8. In hoeverre dienen de besluiten die de betrokken partijen maken met betrekking tot de infrastructuur (planning, onderhoud, aanleg, investeringen)
  - a. Gelijkwaardig te zijn (geen autoriteitsverschil)?
  - b. Gecoördineerd te worden, zodat ze afgestemd worden op de wensen van alle betrokken partijen?