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How can procurement contribute to network performance? Streamlining network, project and procurement objectives.

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Abstract

The core business of governmental organizations like Rijkswaterstaat in the Netherlands is the optimal management of road- end waterway networks. The coming years many maintenance, renewal and extension projects will be executed in these networks. Projects give a disturbance in functionality of the network. Network management is to keep this disturbance as low as possible and make functionality of the networks as high as possible. In reality however projects define their own objectives.
To realize projects market involvement is necessary. Rijkswaterstaat has a procurement policy which aims at optimizing the transaction i.e. best quality for a competitive prize. However, through projects and transactions objectives seem to fade away from the core business of Rijkswaterstaat.
Involvement of the market in public networks is about finding the right balance between keeping control on product and production processes and shifting freedom in design and related responsibility to the market. The more freedom is given to the market in the project transaction, the more difficult it is to manage the network on super project level. Dutch government policy tends to shift more and more freedom and responsibility to the market. A comparison with other types of networks shows that this is adverse to the policy in more business driven networks. Disturbances are kept as short and controlled as possible.
The main question in this paper is how value optimization in projects and procurement can add value for network governance in public networks and at the same time leave enough design freedom to the market for the development of a more resource based construction industry in infrastructure. From the comparison of different networks potential instruments are discussed.

Keywords: network governance, network performance, public value chain, transaction, construction market, procurement, project management, incentives, network and customer value

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1. Introduction

Rijkswaterstaat[2] is responsible for the governance of three national networks: the main road network (5.701 km), the main waterway network (7.609 km inland and 4.100 km sea channel) and the main water system (65.250 km2).
Network governance concerns the optimal functioning and maintenance of the existing network and the realization of improvements for better future functioning. Maintenance, improvements and construction of extensions are realized trough projects. Figure 1 gives an overview of projects started in 2010 in the main road network.

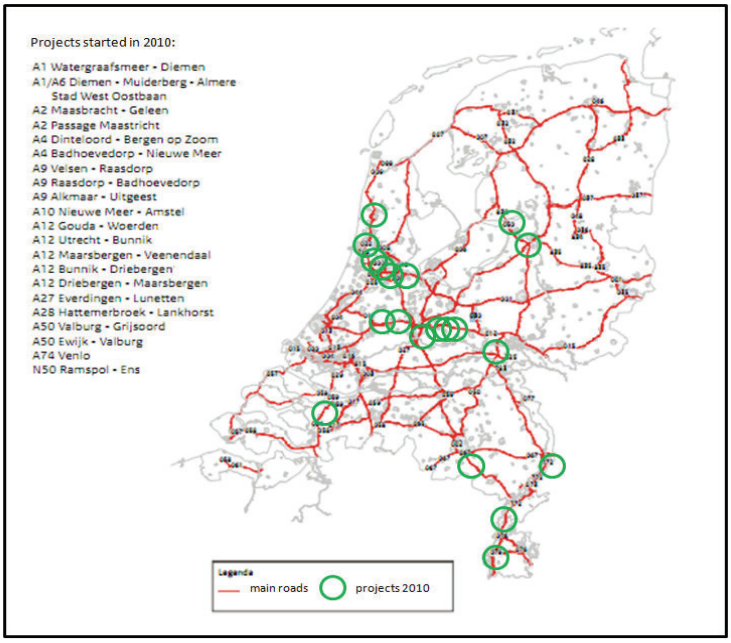

Figure 1: Projects started in 2010 in the main road network.

Projects disturb the optimal functioning of the existing networks. The paradox is, that maintenance, improvement and extension projects are inevitably needed for a well functioning network on the long run. Without projects the network will decline in functioning either by deterioration or by not fulfilling newly developing societal demands. Good network governance relies on the monitoring and control of everything that happens in the network (de Bruijn & ten Heuvelhof, 1997; de Bruijn & ten Heuvelhof, 2008; Kickert & Koppejan, 1997; Klijn, 1997; Koppejan & Klijn, 2004). So projects should be programmed and designed with as minimal disturbance as possible. For programming, information about the expected amount and length of the disturbance and possible measures to influence this are needed before the actual execution of the works. Lack of information gives uncertainty and uncertainty leads to poor network control.

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[2] Rijkswaterstaat is a executive part of the Ministry of Infrastructure and Environment in the Netherlands. Rijkswaterstaat is responsible for the realization of the policy as defined by the Ministry.

For the realization of projects Rijkswaterstaat needs the construction market. A healthy construction market must ensure Rijkswaterstaat of high quality competitive offers now and in the future. These offers should contribute to the functioning of the networks, which is after all the core business of Rijkswaterstaat. Therefore the market policy of Rijkswaterstaat has two sides. One is focused on getting customer value (maximum network availability for a reasonable price), the other is focused on creating opportunities for the development of a durable dynamic construction market based on value competition.
Recent strategy literature shows that differentiation based on specific company competences and resources is a better way to compete than price competition (Barney, 2010). The current construction market in the Netherlands is still mostly based on price competition. According to Porter (Porter, 1996) is "competition based on operational effectiveness alone is mutually destructive, leading to wars of attrition that can be arrested only by limiting competition". Companies need to differentiate themselves from competitors. "Competitive strategy is about being different. It means deliberately choosing a different set of activities to deliver a unique mix of value" (Porter, 2008).
A shift to more resource based competition can help to develop a durable dynamic construction market (Manley & Blayse, 2004; Matthyssens & Van den Bempt, 2008; Matthyssens, et al 2006; Prahalad & Ramaswamy, 2004). More opportunity for the market to offer their own solutions instead of pre described solutions by the government is viewed as necessary (de Ridder, 2006). Early market involvement, functional specifications and awarding on a price/quality basis can help (Lenferink, et al 2011; Mosey, 2009; Valkenburg, et al 2008).
However, giving design freedom to the market results in relative uncertainty about the developed solutions. Muller and Turner (Muller & Turner, 2005) define an agency relationship as a 'contract under which one party, the principal, engages another party, the agent, to perform some service on their behalf which involves delegating some decision making authority to the agent.' Except for the specifications, which have to be met, only incentives can direct the market in the choice of their solutions (Bajari & Tadelis, 2001; Bower, et al 2002). But incentives just stimulate, but give no certainty.
Combining the objectives of getting customer value based on network performance and stimulating the development of a durable value based competition in the construction market seems a dilemma. The key to this is the transaction between the client (Rijkswaterstaat) and a market organization (Caldwell, et al., 2005). Through this transaction the client can optimize network control and stimulate the market.
In this paper a comparison [3] will be made between the network governance used in industrial (commercial) networks and the pure public networks governed by Rijkswaterstaat. The comparison will be made on the following aspects:

- main characteristics of the networks;
- practice of network governance and management;
- transaction structure and market involvement.

This comparison is based on a qualitative study applying interviews (Hennink, et al 2011) carried out at Akzo-Nobel, DSM, Cargill and Rijkswaterstaat[4]. The aim was to get insight in how the respective organizations control their networks, given that they have to refurbish and extent their networks.

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[3] The presented comparison is part of a more elaborate research program into the relations between network performance and network management, project management and market involvement trough transactions.

[4] In this paper pure industrial networks are compared with the pure public networks of Rijkswaterstaat. In a next phase this research will be extended with interviews with managers at combined commercial and public networks like TenneT (electricity network) en Prorail (Dutch railway network) and international railway networks like the London Underground and the Paris subway system.

Interviews were performed on different levels in the organizations i.e. policy making, network and program management, project management and procurement (the value chain).
The next paragraph describes the current practice of network governance of Rijkswaterstaat (network value chain). From this description the key position of the transaction between client and market is shown. Then the current practice of structuring the transaction between Rijkswaterstaat and the construction market is described. The objective is to identify distinctive parameters for the comparison of the networks in the next paragraphs. From the comparison of the different networks potential instruments are discussed that may help to achieve better public network governance and stimulate the development of the construction market.

2. Current practice of network management

As stated before, Rijkswaterstaat is the **national network[5] manager** for the main road and waterway networks in the Netherlands (Rijkswaterstaat, 2010, 2011). This role implies maximizing the use of available capacity of the network through **traffic management** and providing needed capacity in time as an **infrastructure provider[6]**. The best way to keep control on network performance is not to disturb functioning. Projects on one hand lead to disturbance of functioning , but on the other hand are deliberately planned to keep the network functioning at a certain level (maintenance projects) or to improve functionality (refurbishment and extension projects).Combination of the roles of traffic manager and infra provider is managed by intense programming of the planned maintenance, refurbishment and extension projects (Busscher, Tillema, & Arts, 2010; Tak & Wijnen, 2007).
Beside national network manager Rijkswaterstaat is the **professional projectmanager** for all projects in her networks. A project not only has impact on the network, but also on its (local) environment. Professional project management (PMI, 2001) implies minimizing network disturbance, maximizing the planned improvement of capacity and keeping the impact of the project on its environment at an acceptable level (Hertogh & Westerveld, 2010).
Rijkswaterstaat uses the construction market to realize projects through a market transaction in her role as **professional client** for the market. Traditionally, the private sector is engaged at the end of the plan development stage on the basis of a request for proposals. This is mostly after the conceptual design is finished and the main decisions have been made. The private contractor would then be responsible for making the final design[7] and for the realization and separately the maintenance of the infrastructure.
Figure 2 shows an overview of the public network value chain.

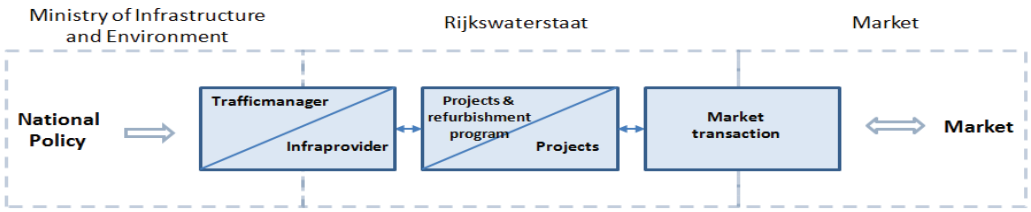

Figure 2: The public network value chain. From national policy to market involvement.

[5] Network is defined as the physical road and waterway networks.
[6] Rijkswaterstaat divides this function in national and regional traffic managers and infrastructure providers. In shared cooperation they define and manage the project program for maintenance, refurbishment and renewal.
[7] In the conceptual design as provided by the government, usually 50 to70 % of the work is specified.

Every transition in the chain is a client-supplier relationship. In the value chain essentially four management levels can be distinguished: the policy makers (Ministry of Infrastructure and Environment), the network manager (traffic manager and infrastructure provider), the project manager and the tender manager or transaction manager of the market. Every level manages and prioritizes objectives from its specific perspective. It shows clearly, that without central programming and goal alignment in the whole value chain objectives may well fade away from the core business through differential prioritization.
In this paper we focus on the transaction between Rijkswaterstaat and a market organization and use the term transaction to refer to this step, although in figure 2 more transaction steps can be seen. The transaction is defined as a coherent set of governance instruments in the interaction between Rijkswaterstaat and a market organization to effectively and efficiently realize customer value in a project. The transaction is more than just the contract. It also implies contract preparation, procurement and contract coordination during realization. Customer value is defined as the value the market supplies to Rijkswaterstaat through the transaction as a contribution to network performance. To contribute to network performance every transition in the value chain, including the transition to the market, needs to be lined up (goal alignment) with the needs of the network manager.

3. Connecting public and private value chains trough the transaction

3.1 The transaction

The public value chain (plan-and decision making) and the private value chain (production and/or service) meet in the transaction. The transaction directs the results of the private value chain and so determines what customer value will be delivered (Male, Kelly, Gronqvist, & Graham, 2007; Morledge, Smith, & Kashiwagi, 2006). According to Williamson and Winch (Söderholm, Gemünden, & Winch, 2008; Williamson, 2010) the primary purpose of a contract[8] is to deal with uncertainty, given that project environments are uncertain, given that contracts are always incomplete, given that parties act opportunistic and given that there is always information asymmetry between client and supplier. Muller et al (Muller & Turner, 2005) note that 'because contracts are incomplete, a flexible and farsighted governance structure is required for every contract'. The more uncertainty, the more measures to deal with this will be incorporated in the contract (Turner, 2004). Getting more certainty on the clients side however, means less freedom for the market to come with their own solutions.
Williamson describes a transaction as a combination of transaction structure and transaction culture (Williamson, 1996, 2010).The transaction structure includes all measures (both by Rijkswaterstaat and the market party) necessary to initiate, prepare, realize, offer, award, coordinate, manage and end the contract (Denise Bower, 2003). The transaction aims at effectively and efficiently realizing the project objectives given a certain context of the project (customer value).
An overview of typical transaction instruments as applied by Rijkswaterstaat (transaction structure) is given in Appendix A (see also (Lenferink, et al., 2011)) .
Through time a certain transaction culture has developed between Rijkswaterstaat and the construction market (Geels, 2005; Rip & Kemp, 1998)[9]. This includes norms and values, habits and roles in their interaction. This paper does not further elaborate the specific cultural aspects of the Dutch construction industry (a recent research in cultural aspects of the Dutch construction industry is given in (Pries, Kamp,

[8] Williamson uses in all his publications contract for transaction..
[9] In literature culture is sometimes described as a regime. A regime is defined by Rip and Kemp as the whole of implicit and explicit rules and patterns that directs people or organizational action. Through feedback this action reinforces the regime.

& Lintelo, 2009). Brink gives in (Brink, 2009) an insight in the cultural aspects of the Rijkswaterstaat organization.

3.2 The market policy of Rijkswaterstaat

The transaction is directed by the market policy of Rijkswaterstaat[10].In 2001, the practice of forbidden price arrangements came to light in the Dutch construction industry, leading to a parliamentary enquiry in 2002 (Bouwnijverheid, 2002; Vulperhorst, 2005). This enquiry revealed a deep dissention about the modus operandi in the sector. The government doubted the existence of real competition. The market dissented the government procurement methods mostly based on detailed specifications and awarding on lowest prize, which pushed the market in prize competition (see also (Adamson & Pollington, 2006; Egan, 1998; Latham, 1994). Both government and market agreed that this had to change (Bouwend Nederland, 2006; EZ, 2003; Regieraadbouw, 2004).Under political pressure the initiative for change was credited to big clients like Rijkswaterstaat. Rijkswaterstaat had to become smaller, more effective and more user and environmental oriented (Metze, 2010), fitting the neo-liberal politics at that time (Gaebler & Osborne, 1993). Executing the same task with less employees, means more involvement of the market (Brink, 2009). Rijkswaterstaat adapted the principle *"market, unless…"*. This means that the market should be involved in every task Rijkswaterstaat cannot do or want to do herself and in every task the market can execute more efficiently or better (added value). Rijkswaterstaat only executes her core tasks (network management) and some tasks needed to preserve knowledge and experience.

In the recent Corporate Strategy 2015 (Rijkswaterstaat, 2011) two objectives are added, through which Rijkswaterstaat wants to develop herself further ("We (Rijkswaterstaat ed.) realize complex infrastructure projects and use the knowledge and experience of the market to create new and sustainable solutions"):

- *The network is leading.* The present situation and programmed development of the networks determine the scope of projects. The needed performance determines the contract.
- *Upscaling market involvement.* RWS involves the market early in the planning and programming process and challenges the market to develop innovative solutions (Lenferink, et al., 2011), (Rijkswaterstaat, 2010).

The market policy (Rijkswaterstaat, 2009) has two simultaneous objectives: the creation of network value through the transactions in the projects and the stimulation of resource based competition to develop a durable dynamic construction market.

[10] The market has its own tender policy, deciding how and with whom to do business. Both the market policy of Rijkswaterstaat and the specific tender policy of a market organization determine the transaction.

4. Comparison of network management and market involvement between public and commercial networks

A comparison is made between a pure public network like the networks of Rijkswaterstaat and pure commercial or industrial networks (Akzo-Nobel, DSM and Cargill). The comparison of main characteristics of the different networks is presented in Appendix B, the comparison of the governance methods used in the networks is presented in Appendix C and the comparison of the applied transaction structures in the different networks is presented in Appendix D. Table 1 summarizes the comparison with respect to the way of creating network value and the way of stimulating the development of the market.

	Industrial Network	**Public Network**
Creation of network value	Totally controlled interventions based on clearly defined output	Tendency to longer and more bundled contracts, performance based[11]
	Centralized system management (programming) and system responsibility by the client	Mixed, partly coordinated, project, maintenance and traffic management.
Stimulation of resource based competition	Design freedom before contract award (D + E&C type[12]).	Design freedom based on functional specifications (DB type[13]) and economically most advantageous tender.
	Quality assurance based on past performance and long term cooperation.	Quality assurance partly based on past performance (pre selection) and contract monitoring. Project based cooperation.

Table 1: Summary of industrial and public network comparison

A network can be defined as a system of knots and connections or relations between them (Bovens, 't Hart, van Twist en Rosenthal, 2001). Through flow the network becomes dynamic. Flow generates income, directly trough sales, or indirectly trough taxes paid by the users of the network. Since the network is an investment the target is to maximize functionality through network management.
The main characteristic of a commercial or industrial network is that income from sales is directly connected to network production. Maximization of production is therefore the main target. Disturbance in production leads to profit losses. Feedback from the system to the management is short and enables fast action if necessary. Network governance is mainly focused on production (optimal logistics, lean production). The network is the production tool to generate return on investment and profit.
Public networks differ from commercial networks in time and spatial scale. Public networks mostly have more spatial impact and concern long time investments. Feedback is longer and mostly indirect (via politics). This makes adequate reaction on disturbances and so network management difficult (Arts, 2007). Rijkswaterstaat programs their projects on a national scale. However projects are mostly locally orientated (local environment determines aspects as time, costs and disturbance). Production is measured

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[11] The reason is mainly less coordination costs, shifting of responsibility to the market and assumed better quality.
[12] Design plus separate engineer & construct.
[13] Design-build.

as amount of money spent in projects[14], instead of functionality of the network. Budget management in this sense is the key management driver within Rijkswaterstaat. Management is directed to meeting the programmed production instead of delivering maximum functionality.
Production in commercial networks is directly related to functionality. Less functionality leads to less production and so less profit or stakeholder value. So everything that can make functionality better is a potential profit maker. Governance is therefore uniformly directed at maximizing functionality. Pure public networks have mixed governance, mostly based on project management, maintenance management and traffic management in a mixed and changing prioritization.

5. Analysis and discussion

The best control over a network exists when before the intervention the impact of the intervention is exactly defined. So when no uncertainty exists about scale, duration, quality and costs of the intervention. The market just delivers pre specified output.
However, Rijkswaterstaat wants to give the market some freedom to create their own solutions. This may result in a better prize/quality balance and helps to reduce personnel for preparation of the contracts and supervision (neo liberal policy).
Moreover, giving *design freedom* to the market can help to develop a durable competitive construction market based on quality competition instead of prize competition. The market can offer solutions based on their specific knowledge, experience and resources, which differs them from their competitors.
Giving freedom to the market does not directly result in loss of network control. Commercial firms give freedom to the market before contract award, but take over responsibility by according the proposed design and construction method before realization.
Real uncertainty only comes from giving design freedom in combination with *shifting responsibility* to the contractor. Getting responsibility for proposed output or outcome implies bearing the related risks[15]. The contractor can bear risks if he is able to control them. This implies, that the contractor is free to choose between different alternatives he considers necessary to control this risks. This relative freedom of choice implies *uncertainty* to the client about product and production process and related impact on environment and network. Incentives can help to drive the contractor in a certain direction. However, incentives are just stimulations, but give no certainty.
Traditionally the contractor was only responsible for the actions needed to construct a design made by the client. Especially the public sector has (recently) made a shift to more outcome and performance based contracts. In outcome based contracts the market gets the responsibility for the product, for the functioning of the product and for the expected outcomes or performance.
When giving freedom and responsibility to the market, network governance concerns dealing with uncertainty. How can uncertainty be managed?
The comparison between public and industrial networks as presented shows some possible approaches:

1. Giving only freedom, where uncertainty does not affect network programming. This means, that the client precisely specifies the opportunity window for the market (engineering & construct);
2. Giving freedom before award of the realization contract and specifying an accorded design and construction method in the contract (design plus build). Giving freedom can be through non

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[14] In the public network of Rijkswaterstaat this is sometimes called production management, however the term production refers here to the turnover in projects.
[15] In the contract this shift of responsibility is realized by relating the payment system to the expected outcome or performance.

competitive private involvement instruments ,through a competitive dialogue in a procurement procedure or through joint design in a two-stage tender procedure.

3. Giving freedom in the contract through functional specifications (design-build) in the contract in combination with the possibility of intervention in the contract (repair). Incentives can help to reduce the amount of interventions by driving the contractor in certain directions.

In the first approach the client has to perform most of the design himself with corresponding responsibility. Pro is that the client exactly knows the scale of the intervention is his network. However this approach leaves very restricted creative involvement for the market, with hardly any possibility for the market to distinguish from its competitors other than prize.
In the second approach the client takes over the responsibility for the design by according before the realization contract award. At that moment the scale of the proposed intervention in the network is exactly known. It leaves all kinds of possibilities (non competitive, competitive dialogue or cooperation with a preferred contractor) to the client to develop the most suitable design. Depending on the way the market is involved in the design market parties can distinguish on creative and resource based aspects, more than price alone.
The third approach implies most freedom to the market to come with their own ideas and implies most uncertainty to the client. Pro in this approach is that the client can shift most of the responsibility for design and realization to the market. The client can only govern the development of the design by incentives in the contract and by intervention . For this the client has to monitor the development of the design intensely. Intervention means that the client takes back part of the responsibility from the market. This approach can only be applied in projects where no major surprises in the design are expected and one can engineer a strong incentive mechanism. Intervention than is available as a back-up.
In table 2 the three approaches are compared with respect to network control, responsibility shift and stimulation of value based competition in the construction market.

	Network control , degree of certainty to the client about intervention in network	**Responsibility shift to the market**	**Stimulating value based competition by giving design freedom**
Approach 1: Engineering & construct	High	Minimal	Low
Approach 2: Design plus build	High	Minimal	Medium to high
Approach 3: Design-build	Low	High	Very high

Table 3: Comparison of approaches with respect to network control, responsibility shift and stimulation of value based competition.

A preference for one of the three approaches depends on the aspects most relevant for the respective network. In commercial network, network control is eminent, since returns totally depend on the optimal functioning of the network. Therefore approach 1 and 2 are prominent in commercial networks. It is interesting to see that in public networks design-build[16] is the prominent approach. This results from the neo-liberal policy to shift more and more responsibility to the private sector and the new market policy since the frauds in the construction industry. These two aspects seem to overwhelm the prime responsibility of organizations like Rijkswaterstaat i.e. network management.

[16] Design-build is the standard contract for extension projects in Rijkswaterstaat market policy.

6. Conclusion

This paper started with the dilemma of combining the objectives of getting customer value based on network performance and stimulating the development of a durable value based competition in the construction market. The key to this lies in the transaction between a client (Rijkswaterstaat) and a market organization. Through this transaction the client can optimize network management and stimulate the market.

As stated in paragraph 2 of this paper, central programming of the projects in the network is the key for optimal network management (**programming**). The program determines terms of reference, constraints, objectives and needed flexibility of the separate projects[17]. From this the design freedom for the market in the transaction is derived and incentives are specified. The whole chain from program through projects to transactions should be aligned in their objectives (**goal alignment)** at which overall network performance is the central theme and should give enough stimulation to the subsequent management levels to direct the chain. Goal alignment creates an incentive in the different management levels in the chain including the transaction with the market to go for the same objectives.

There will always be uncertainties about the development of the program. Therefore, it is necessary to incorporate a possibility to intervene in the contracts (change management clause) if necessary from the program point of view (**flexibility**) [18].

From the analyses as given before it can be concluded that pure design-build might not be the optimal approach form to balance network control and market freedom. A model based on a combination of design plus build and design-build might work better. The basis is subsequent design plus build, separated by the fixation of (most of) the design before build. Through fixation of the design before actual realization the scale of the intervention in the network is clear beforehand. Parts of the design can be left open for further elaboration under functional specifications in a design-build. The part that can be functionally specified is determined by the central programming and the level of network control necessary. This model leaves all kind of possibilities to optimize the design through early market involvement ranging from non competitive involvement, competition through competitive dialogue to cooperation with a preferred contractor under a service agreement for the design.

A consequence of the design plus build model is that the client takes part of the design responsibility back from the contractor by approving the design. This seems to be the price one has to pay for optimal network control.

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[17] Besides the network, also local circumstances can add to the terms of reference and constraints of a project.

[18] This is related to the actual value for money discussions in Australia concerning the application of alliance contracts and the UK concerning the application of PFI contracts (Private Finance Initiative).

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Appendix A: Transaction structure as applied by Rijkswaterstaat

Phase:	Instruments:	Explanation:
Non competitive early private involvement	Unsolicited Proposal, market consultation, market reconnaissance, design contest	Non competitive instruments for generating market knowledge and experience to be used in planning and decision making.
Contract initiation	Market scan	Assessment of potential value for money, identification of market parties which may offer this added value are identified and determination of the market approach.
	Market Consultation	Private assessment of the feasibility of a proposed scope, technical solution or process worked out by the government
	Public Private Comparator	Assessment of potential added value of a public-private partnership over a traditional construction contract like design-built.
Procurement	Announcement, general information, application, selection and invitation to tender	Formal start of a public procurement procedure
	Competitive dialogue	Procurement procedure for specific contexts conform EU regulations
	Design	Current practice is that the government finishes the design for 50-70% before procurement. A (competitive) dialogue is mostly used to finish the design for judging and awarding (80-90%).
	Specification of requirement	Terms of reference and constraints.
	Request to bid and bids	Committed bids by for supplying described quality for a certain price
Contract award	Contract	Standard outcome based maintenance contracts, design-built contracts for main refurbishment and extension projects and design-built-finance-maintain contracts for specific extension and maintenance projects.
	EMAT[19]	Instrument to evaluate committed bids for best price/quality balance.
	Public Sector Comparator	Quantitative instrument that compares the costs of private delivery with that of public delivery
	Negotiation	Procurement procedure for specific contexts conform EU regulations
	Financing	Budget assignment and financial close.
	Contract close	Final award of contract
Contract management	Stakeholder coordination	Coordination of stakeholders involved in the project
	Permits	Managing clients contractual obligations
	Contract management and payments	System Oriented Contract Management. Indirect supervision based on contractors information and auditing[20].
	Monitoring	Monitoring actual development and evaluation.
	Change management	Coordination and management of changes initiated by the client or the supplier..
Contract ending	Final delivery and transfer	Contract ending and evaluation of contract performance

[19] Economically Most Advantageous Tender

[20] In Dutch this way of supervision is called “Systeem Gerichte Contract Beheersing” (System Oriented Contract Management). The idea is that when the quality system of the contractor is in control, the system will always deliver good products. The client audits the working of the quality system based on risk management. The results are related to the payment system, so the contractor has a financial incentive to work according to his quality system.

Appendix B: Network comparison of main characteristics

	Industrial network	Public network (Rijkswaterstaat)
Governance	Direct relation between functioning, output and return. Short feedback.	Indirect relation between functioning and societal output. Slow indirect feedback.
	Direct governance based on production	Mixed governance based on traffic management, maintenance and projects.
	Netwerk output is production	Project turnover is production
	Redundancy in critical elements	No redundancy
	Full utilization of available capacity	Many bottlenecks in capacity
	Pro active risk management (time is money)	Reactive management (event driven)
	Focus on maintenance. Incidentally large renovations and extensions.	Focus on renewal and extension projects. Maintenance lower concern (not sexy).
	Shareholders only globally financially involved	Projects are politically sensitive (sexy)
Spatial scope	Limited spatial impact.	Projects have significant spatial impact, strict regulation.
Financial scope	Projects are investments (business-case)	Projects involve costs.
	Huge basic private investment, during lifetime mostly maintenance..	Huge basic investments from the past, continuous huge investments in renewal and extension projects.
Time scope	Relatively short term planning (< 25 years), low degree of environmental change.	Long term planning (50 to 100 years), significant societal and environmental changes.

Appendix C: Network comparison of network management method

	Industrial network	Public network (Rijkswaterstaat)
Policy	Critical components for production are redundant	Redundancy is very costly and hardly realized..
	Extra investments in robustness (life cycle) to reduce incidents and maintenance.	No extra budgets available for robustness. Investment in robustness means less investments in improvement..
	Every project in the network (maintenance, renewal or extension) is centrally governed by the own organization. Own organization bears system responsibility.	There is not a real overall system manager. System management is the coordination between traffic management and infraproviding..
	Production management on functionality is leading	Mixed management on projects, maintenance and traffic..
Program management	Program management coordinates the projects. System manager prioritizes in the program.	Projects are mostly leading and determine the program.
	Projects are short in duration, clearly defined before the actual work and totally controlled (output).	Projects are long in duration: D&C construction time average of 5 years, performance based maintenance contracts average of 5-7 years en DBFM up till 25 years.. Contract responsibility is more and more outcome based.
Project management	Design freedom for the market only before awarding. After awarding work is totally specified. Main contract type is design plus built instead of design-built.	Awarding based on judgment of the bid design, which is based on clients functional specifications.
	Design is made in dialogue and cooperation between client and potential contractor.	Design is (mostly) made in competitive dialogue and information exchange between client and potential contractor.
	Scope and time management is leading. Costs are third.	Time and cost management is leading. Changing prioritization. Quality is third.
	Standard contracts	Standard contracts.
Contract management/ market involvement	No system responsibility for the market, only output responsibility.	Outcome responsibility for the market..
	Quality of the market is assured through partnering (past performance) en strategic alliancing.	Public procurement with quality selection. Past performance is under development.
	No innovation in the main networks. Innovation through co-creation and development.	Innovation in the projects. Relatively small national innovation program.

Appendix D: Network comparison of applied transaction structure

	Industrial network	Public network (Rijkswaterstaat)
Non competitive early private involvement	Co-development apart from network.	Early private involvement instruments
Contract preparation and procurement	Private procurement not under EU regulations.	Procurement procedures under EU regulations.
	Procurement on invitation based on performance	Public procurement
	Selection based on pre-design and most fit for the job.	Selection base d on eligibility specifications.
	Design cooperation before awarding. Construct after clients approval of design and work method..	Bid design made in competitive dialogue.. Design –built award based on accepted bid design..
Contract	Design plus built for renovation and extension. Award based on pre approved design and construction method.	Standard design-built for renovation and extension based on functional specifications.
	Standard output contracts for maintenance.	Standard performance based contracts for maintenance.
	Co-development arrangements and strategic alliances.	Standard DBFM contract for large renovations and extensions in specific contexts.
	Incentives through past performance en penalty and/or en/of pain/gain system.	EMAT awarding,, penalties, pain/gain system. Application of past performance under development. Performance payment in maintenance contracts and DBFM.
Contract management	Direct supervision during execution.	Indirect supervision based on contractors information and auditing[21].
	Direct monitoring en contractual possibility of clients intervention if necessary.	Indirect monitoring, restricted contractual possibility of clients intervention if necessary.

[21] In Dutch this way of supervision is called “Systeem Gerichte Contract Beheersing”. The idea is that when the quality system of the contractor is in control, the system will always deliver good products. The client audits the working of the quality system based on risk management. The results are related to the payment system, so the contractor has a financial incentive to work according to his quality system.