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Towards sustainable infrastructure development through integrated contracts: Experiences with inclusiveness in Dutch DBFM projects

ABSTRACT

Current complex society necessitates finding inclusive arrangements for delivering sustainable road infrastructure integrating design, construction and maintenance stages of the project lifecycle. In this article we investigate whether linking stages by integrated contracts can lead to more sustainable road infrastructure development by assessing Dutch experiences with inclusiveness of Design-Build-Finance-Maintain (DBFM) projects in the dimensions of actors, scope and time. We examined practical public and private experiences through semi-structured interviews and document analysis. We find that in practice the closed procurement stage often results in a conservative, detailed contract. Awarding on quality criteria can stimulate inclusiveness in the actors and scope dimensions, and therefore provide possibilities to increase sustainability. In construction and maintenance, cooperation between actors has improved due to lifecycle linkages. However, in the time dimension the relation between integrated project and infrastructure network needs further optimization. We conclude that integrated contracts can lead to optimizations by lifecycle costing and management because of linked stages in the project lifecycle and recommend pursuing three avenues towards sustainable infrastructure development: green procurement, strategic asset management and relational contracting.

1. INTRODUCTION

Over the last decades, projects have become increasingly complex ([Williams, 1999](#)), which is also recognized in Dutch road infrastructure projects ([Arts, 2007](#)). Traditional project management approaches cannot account properly for increased complexity in the planning arena. As a result, ‘implementation gaps’ ([Dunsire, 1978](#)) between stages in the lifecycle of projects occur: between government-dominated plan-making, and implementation, dominated by the private sector. As a result, planning processes for new road infrastructure proceed slowly and regularly come to a standstill and completed projects show shortcomings in cost and time overruns ([Committee Elverding, 2008](#); [Flyvbjerg, 2005](#); [Cantarelli, 2011](#)). In addition to the shortcomings in time and costs of the current transport planning process, other challenges are emerging that are related to the quality of infrastructure projects: Infrastructure delivery is increasingly aimed at increasing the specific quality of achieving long-term sustainability. This could be realized by increasing the inclusiveness of infrastructure projects, by looking for new partnerships ([Wakeman, 1997](#)), which transcend the traditional economic, social and ecological pillars of sustainability that are proposed in the Triple Bottom Line ([Elkington, 1999](#)).

Increased inclusiveness can be found by stressing the linkages, interconnections and interdependencies that are inherent to the concept of sustainability ([Gibson, 2005](#)). Along this line, [Arts \(2007\)](#) proposes to integrate the lifecycle of projects by increasing the inclusiveness in the actors, scope and time dimensions. Increasing inclusiveness in the *actors* dimension would mean that government distributes responsibilities to other actors, e.g.

local stakeholders or consortia of private parties, in such a way that more expertise can be employed. This could better serve the various local and national interests, leading to better balanced outcomes with broader public support. By increasing inclusiveness in the *scope* dimension of infrastructure projects, synergies can be discovered between infrastructure and their surroundings. These can help to improve the overall quality of an area and provide opportunities to arrive at more sustainable solutions ([Heeres et al., 2010](#)). Inclusion in the *time* dimension encompasses linking the stages in the planning lifecycle. Better coordinated and integrated lifecycle stages could enable for improvement of the planning process and the developed product (i.e. the road infrastructure).

In the Netherlands as well as other European countries, the integral Design-Build-Finance-Maintain (DBFM) lifecycle contract is increasingly applied. In a DBFM contract, a private party, often a consortium, is responsible for design, construction, financing and maintenance. DBFM contracts are similar to integrated Build-Operate-Transfer (BOT) and Build-Own-Operate-Transfer (BOOT) contracts, as used in the United States, in the fact that stages are integrated and the funding is a responsibility of the private sector ([Pietroforte and Miller, 2002](#)). As operation in the broad sense includes maintenance, DBFM and Design-Build-Finance-Operate (DBFO) are interchangeable concepts (Bult-Spiering and Dewulf, 2006). However, in the Netherlands, DBFM contracts do not usually involve private parties to become operator and/or owner of the infrastructure and usually tolling is not applied. Private consortia earn back their investments by receiving availability payments during operation. Integral DBFM contracts have only fairly recently been introduced to road infrastructure. Although sometimes difficult to measure because contracts are still in the operation stage ([Nilsson, 2009](#)) and there is a lack of data on operating costs and outputs (Jensen and Stonecash, 2004), the first project outcomes on time and costs through engineering-based systems research have become clear. The implemented Dutch DBFM contracts show possible efficiency gains, increased project control and are delivered better in time and within budget as compared to traditional contracting (WB Consulting, 2009; Committee Ruding, 2008). These first evaluative studies on DBFM projects do, however, only reflect the ‘hard’ components of project management, and disregard the more process-oriented social-science based research that also exists in project management (see [Söderlund, 2002](#)). For example, the evaluative studies merely recognized that cooperation with the private consortia needs further optimization (Dutch Ministry of Finance, 2010) without providing further details or a research agenda. It is therefore still unknown how integral DBFM contracts in practice deal with ‘soft’ components that are more related to process management ([De Bruijn et al., 2002](#)) and process thinking ([Koskinen, 2012](#)). More specifically, it remains unclear how inclusiveness and its actor, time and scope dimensions are perceived and dealt with in the “actuality of projects” (see [Cicmil et al., 2006](#)).

Therefore, in this article we assess from a process-perspective to what extent integral DBFM contracts can contribute to more inclusive road infrastructure projects, and try to answer the research questions: How is quality translated into inclusive, sustainable contracts in Dutch practice?, how can DBFM contracts increase inclusiveness?, and which avenues for increasing inclusivity can be recommended from analyzing linkages between stages in Dutch DBFM contracts?. We focus on how sustainability, and specifically inclusiveness, is translated into integrated DBFM arrangements in Dutch infrastructure planning practice. We analyze how actor, scope and time elements are represented in the linkages present in Dutch integral DBFM contracts by confronting collected experiences regarding inclusiveness in Dutch DBFM contracts from 28 interviews with public and private actors with an analysis

of project evaluation studies and other ‘grey’ literature. We will focus on experiences with integrated contracts in Dutch road infrastructure development, because currently in the Netherlands there is much effort put into advancing practice by rapidly completing a major shift towards integrated contracts. The investigation of Dutch practice is relevant to an international audience because, as part of the broadly applied neoliberal agenda ([England and Ward, 2007](#)) in Western countries, contract integration takes place at a broader, international scale. The findings and conclusions may therefore be applicable to other Western countries as well. In addition, this article relates to the search for ways to incorporate sustainable development into policy and business activities ([Labuschagne and Brent, 2005](#)). The article therefore fits project management after the practice-oriented turn (see [Blomquist et al., 2010](#)), which shifted the focus to the development of projects’ processes over time and includes the wider context and its contingencies and dependencies ([Engwall, 2003](#)).

In the remainder of this article, first, we give a background on the development towards DBFM contracts, after which we provide the theoretical framework and research design. Following that, the issues in stages and linkages of integrated contracts are discussed per project stage: procurement, design, build, and maintenance & operation. In the conclusions and discussion section, the role of inclusiveness and sustainability in the implementation of integrated contracts is discussed. Finally, we provide potential ways for increasing sustainability of DBFM projects: green procurement, strategic asset management and relational contracting.

2. POLICY SETTING: DEVELOPMENT TOWARDS INTEGRATED CONTRACTS

2.1 Historical overview

At the end of the 1990s, the new public management ideas ([Osborne and Gaebler, 1992](#)) resulted in a shift across Western governments: a reassessment of government’s core competences was necessary ([Pollitt et al., 2007](#)) and in a neoliberal agenda of privatization more tasks and responsibilities were distributed to the private sector ([England and Ward, 2007](#)). Executive departments were transformed into agencies: e.g. Rijkswaterstaat in the Netherlands and the Highways Agency in the United Kingdom ([Highways Agency, 2009](#); [Rijkswaterstaat, 2008](#)). Tasks are transferred because it is expected that private contractors are able to identify and develop innovative facilities, deliver more quickly and at lower cost, and can provide private funding and operate facilities more efficiently ([Savas, 2000](#)). In most Western countries the trend towards integrated long-term contracts can be recognized ([Pietroforte and Miller, 2002](#)) and this development is not limited to road infrastructure (see e.g. [Chao et al, 2005](#) on integration in the electricity supply sector).

As in many other countries, in the Netherlands government was traditionally responsible for plan-making, construction and maintenance of road infrastructure. The rather inward-oriented executive department of the Dutch Ministry of Infrastructure & the Environment (“Rijkswaterstaat”) controlled the planning procedure from the beginning to the end, from agenda-setting and explorative studies to management and maintenance of delivered infrastructure ([Arts, 2007](#); [Van den Brink, 2009](#)). Until the late 1990s, Rijkswaterstaat did so by working out the desired solution in detail in a ‘RAW-bestek’: a specification including a detailed technical design with underlying preliminary calculation of materials needed and construction time. Based on this estimate, contractors could calculate their bids and the lowest bidder was awarded the construction contract. After completing construction,

maintenance was performed by public road districts or contracted out in separate maintenance contracts, which were also specified in detail (see Model 1 in Figure 1).

<Insert Figure 1 around here>

In the Netherlands the neoliberal agenda started with outsourcing maintenance to contractors. Specified products and processes were no longer put out to tender, but instead performance levels were required by Rijkswaterstaat in so-called performance maintenance contracts (see Figure 1, Models 2a/2b). Contractors were allowed more freedom to optimize maintenance by applying innovative methods for more efficient maintenance. Shortly after, also the approach to the construction of infrastructure was revised. Contractors were made responsible for working out technical design specifications by establishing Engineering & Construct (E&C) contracts (see Figure 1, Model 2a). Positive experiences with E&C contracts paved the way to more inclusive Design & Construct (D&C) contracts (see Figure 1, Model 2b). Instead of providing an elaborated design in detail, in a D&C contract the contracting authority only requests certain outputs to be delivered, based on the general demands and wishes of involved public parties. In 2008, D&C contracts became the standard form of contracting within Rijkswaterstaat (Rijkswaterstaat, 2008). The next step in the integration of stages in infrastructure projects was taken by introducing Design-Build-Finance-Maintain (DBFM) contracts (see Figure 1, model 3) in which design and construction tasks are combined with performance maintenance over a longer contract period. DBFM contracts are currently the standard for complex projects at the national level in the Netherlands, and are increasingly applied (see Table 1).

<Insert Table 1 around here>

2.2 DBFM contracts

DBFM contracts aim to integrate over *time* the stages of design, construction, and maintenance into a single arrangement. Financing is also a part of the contract, but is set-up in procurement and carried out throughout the other lifecycle stages. The name of DBFM therefore does not reflect the sequence in which the stages and activities take place. Traditionally, design, construction, and maintenance stages are separated and poorly integrated, leading to sub-optimizations (Dorée, 2001). In DBFM contracts, the contractor delivers a service (i.e. availability of infrastructure) during a period that can span 15 to 30 years. Through integrated contracts, government distributes responsibilities to other *actors*, e.g. local stakeholders or consortia of private parties. Potentially more expertise can be employed, which could better serve the various local and national interests, leading to better balanced outcomes with broader public support. In DBFM contracts the tasks in design, construction and maintenance are transferred from the public client to the private contractor. Because government remains client and contracting authority, and, as such remains responsible for strategic planning, DBFM cannot be considered as ‘pure’ privatization (Dutch Ministry of Finance, 2010). By extending and broadening the *scope* of infrastructure projects, i.e. including more activities in (parts of) the road network, synergies can be discovered between infrastructure and their surroundings,

which can help to improve the overall quality of an area and provide opportunities to arrive at more sustainable solutions ([Heeres et al., 2010](#)).

In contrast to Dutch DBFM contracts (Rijkswaterstaat, 2009a), internationally contracts often are expanded to DBFMO contracts (see model 4 in Figure 1), which include private operation by tolling, e.g. in Spain, Italy, the Czech Republic and Germany (BNP Paribas Fortis, 2010; PS, 2010). Tolling is generally not included in the Netherlands because of the historical availability of a good national highway network without tolling in the Netherlands, a heavily urbanized country with little available space ([Van Valkenburg et al., 2008](#)). However, recently three projects with tolling possibilities were identified in national policy of 2011: the A15 highway Ressen-Zevenaar, the A16-A13 highway connection and the Blankenburg highway tunnel near the harbor of Rotterdam (Dutch Ministry of Infrastructure and the Environment, 2011).

3. THEORETICAL SETTING: SUSTAINABILITY AND DIMENSIONS OF INCLUSIVENESS

As described before, we investigate sustainability and inclusiveness in and between different stages of DBFM contracts. In this section, the theoretical backgrounds of the sustainability concept are explored and related to theoretical dimensions of inclusiveness.

Sustainability has been under debate for decades, especially since the UN report ‘Our common future’ (WCED, 1987), after which numerous attempts have been made to translate sustainability into measurable components. A well-known example is Elkington’s concept of the Triple Bottom Line, which proposes three elements of sustainable development: social, ecological and economic ([Elkington, 1999](#)) that also resemble the elements in the People (social), Planet (ecological) and Profit (economic) concept. However, it is difficult to apply these concepts to design, construction and maintenance and subsequently assess their performance ([Chong et al., 2009](#)). Moreover, the definition relies on the traditional economic, ecological and social pillars, which causes continuation of traditional thinking and business-as-usual (Gibson, 2005). Gibson therefore proposes to emphasize the process elements of sustainability that include the linkages, interconnections and interdependencies that are at the core of the concept. Such a definition of sustainability is also suggested by Arts. In his view, sustainability can be achieved by applying more inclusive planning processes. The proposed inclusionary approaches include a shift in the actors, scope and time dimensions (Arts, 2007).

The *actor* dimension comprises of the inclusion of actors in the planning, contracting and implementation process. It relates to theoretical developments in collaborative planning ([Healey, 1997](#); [Woltjer, 2000](#)) and collaborative alliances ([Gray and Wood, 1991](#)), which are reflected in the development from classical to neoclassical contracts (Lyons and Mehta, 1998). Classical contracts include as many contingencies as possible in order to reduce the possibility of claims and disputes’ ([Cheung et al., 2006](#)). In Dutch infrastructure planning, the previously discussed RAW contracts can be regarded as classical contracts, in which the project is carefully hedged ([Collingridge, 1983](#)) from outside influences. In contrast to classical contracts, neoclassical contracts such as DBFM and D&C consider longer time periods, involve more actors and personal interaction and allow for a lower degree of discreteness (Lyons and Mehta, 1998).

The *scope* dimension considers the inclusion of other socio-economic functions in road infrastructure development, shifting the project focus from infrastructure itself to the combination of infrastructure and the surrounding area (Heeres et al, 2010). This expanded focus is necessary because current society is in need of ‘new scales for planning intervention’ (Allmendinger and Haughton, 2009) in order to deal with problems in infrastructure planning. In exploring these new scales, the theoretical concepts of co-development, in which each involved sector brings their values and expertise (Cervero 2009) into the process, in order to come to a ‘mutual gains approach’ (Susskind and Cruikshank 2006). By exploring and extending traditional project boundaries to incorporate for opportunities in adjacent sectors, potential synergies could be discovered. These could enable a transformation from mono-functional to multi-functional development and facilitate more inclusive development (Arts, 2007).

The *time* dimension reflects the integration of stages in the project lifecycle. Currently, stages are separated and poorly integrated (Dorée, 2001), leading to implementation gaps (Dunsire, 1978). By connecting stages better, interaction could be realized in which knowledge and expertise could be used to better adjust activities to each other (Bult-Spiering et al., 2005). These ideas are also reflected in the work on supplier integration (Martinsuho and Ahola, 2010) and manufacturing sector life cycle integration (Labuschagne and Brent, 2005). Creating opportunities to perform lifecycle optimizations could enable to better realize project goals and connect to stakeholders’ interests. In doing so, more inclusiveness regarding the time dimension can be realized (Arts, 2007).

In this article we adopt a process perspective on sustainability by focusing on inclusiveness and the three dimensions actors, time and scope. This is done partly because a focus on inclusiveness fits within project management’s increasing attention to process management (see De Bruijn et al., 2004) and the actuality of projects (Cicmil et al., 2006). But, more important, we think that the actor, scope and time framework better reflects the collective and transformative character the systems change towards sustainability. Inherent to the process perspective on sustainability is an incentive to seek relations with and to relate to other dimensions. Such an incentive is not as strongly present in the more product oriented approaches, such as the triple bottom line approach (Elkington, 1998).

4. RESEARCH DESIGN

In this article we assess how inclusiveness is incorporated and dealt with in integrated lifecycle contracts. To this end, we examined issues and experiences with inclusiveness in the procurement & design, construction, and operation & maintenance stages of large Dutch infrastructure DBFM projects. As this article aims to reflect on the important issues in integrated contracts, it will discuss and compare the main trends as they emerge from document analysis and interviews.

Documents analyzed include evaluative studies carried out by the Dutch Ministry of Infrastructure and the Environment and consultancy agencies. The evaluations cover the introduction of new contracts, the performance of contractors and issues related to inclusiveness. We selected documents that consider Dutch planning practice and analyzed them for the actor, scope and time dimension. Subsequently, we confronted document analysis findings with the findings from interviews.

Interviews were conducted with actors involved in the implementation of DBFM contracts in road infrastructure projects: the A15 Maasvlakte-Vaanplein, the Second Coentunnel project, the A12 Utrecht-Veenendaal, the A59 Rosmalen-Geffen and the N31 Waldwei. These interviewees include public and private legal, financial, planning and management experts in the Netherlands (see Appendices 1 and 2 for an overview) that were selected because of their expertise in working with DBFM projects. In addition, they reflect a broad range of fields of expertise. The majority of the 28 selected interviewees works for construction companies or at the Dutch Ministry of Infrastructure and the Environment. The semi-structured interviews, conducted in the period November 2009 to March 2011, allowed a structured discussion of predetermined issues and developments, as well as flexibility for the interviewee to include personal experiences and discussion topics (Liamputtong and Ezzy, 2005).

The interviews and document analysis enabled us to gain in-depth knowledge in the DBFM projects. The limited amount of DBFM projects and the fact that the DBFM projects have not reached the end of their contract periods make such a qualitative study both relevant and appropriate. Projects are often still under construction (see Table 1) or early in the maintenance stage. In the interviews and the document analysis, the topics addressed relate directly to the process-based inclusiveness dimensions described in the theoretical setting: actors, scope and time. In all dimensions, the opportunities and limitations for increasing inclusiveness were explicitly discussed.

- Regarding the *actor* dimension, the aspects investigated cover the cooperation between involved actors, which consist of stakeholders and shareholders from government, market and civil society. The topics researched are the cooperation between public client and private contractor, the relation of client and contractor with civil society, and the relation between the involved project and line organizations.
- The dimension of *scope* is operationalized by investigating issues in the project scope. This primarily includes the relation between project scope and surroundings at project level.
- The discussed topics in the *time* dimension are the relation between the contract stages, and the way these are integrated and information is exchanged. This includes the relation between the part of the infrastructure included in the project and the infrastructure network at a higher level.

One can how the dimensions are connected and possibly overlap, which is essential for the inclusiveness perspective on sustainability. For example, spatial claims (*scope*) are negotiated between stake- and shareholders (*actors*) in order to adjust construction and maintenance (*time*) to each other.

In the practice section, the findings are grouped along the different stages of integrated contracts: design & procurement, construction, and maintenance & operation. These stages represent parts of the project life cycle for which a range of similar names exist in international project management ([Labuschagne and Brent, 2005](#)). Procurement is also included because it plays an essential role in the setup of the DBFM contract. Also procurement activities are closely linked to design activities and because procurement is often performed simultaneous with design. The discussion of the maintenance stage is combined with the operation. This is done because these activities are related and performed simultaneously.

Financing is deliberately not a part of the discussion in the next section, because financing is not a separate stage, but plays a role in procurement, design, and maintenance stages. In addition, in Dutch DBFM contracts government remains responsible for arranging the funding of the infrastructure. Although there is no active role for

private financing, a Finance component is included in Dutch DBFM contracts. Private financiers are sought for participation to provide a check for feasibility of proposed plans and often paid by the contracting authority on the basis of road availability during construction and maintenance. The interviewees indicate that including the Finance component can help in arranging funding, because it offers business opportunities to materialize efficiency gains in DBFM projects. Finding private financiers by including a Finance-component in DBFM contracts can stimulate the search for new sources of funding and can assist in developing a more businesslike perspective on road infrastructure investments. The banks or institutional investors that act as financiers aim to secure investments and therefore closely control project performance (see also Ministry of Finance, 2003; [Eversdijk and Korsten, 2008](#)).

5. PRACTICE: INTEGRATED CONTRACTS IN THE NETHERLANDS

In this section, for each stage investigated, design & procurement (5.1), construction (5.2), and maintenance & operation (5.3) first a general description of section will be given. This description of each stage includes issues related to linking to the previous stages. For example, the discussion of the construction stage will also cover the link with the previous design & procurement stages. Afterwards, for each stage the three dimensions of inclusiveness will be discussed for the different stages of DBFM projects: first based on the document analysis, secondly on the interviews and illustrated by quotes

5.1 Design & Procurement

In the design and procurement stages of DBFM projects, inclusiveness and sustainability become visible in the way government's wishes and ambitions are translated into procurement preconditions and awarding criteria. Designing road infrastructure is a major part of the preparatory activities and largely determines the manner of construction, maintenance and operation. Procurement implies political decisions to be made beforehand on the project's objectives, constraints and requirements. To make such decisions, the public planning procedure attempts to rationally limit the uncertainties involved in the project, contract and procedure by applying hedging ([Collingridge 1983](#)). Public authorities gather data and work out alternatives until a desired level of certainty is reached (Committee Elverding, 2008), and request detailed bids from private parties in procurement, when projects are published in the Official Journal of the European Union. Examples of regulations and guidelines that channel this demand for detail are the guidelines for applying the competitive dialogue procurement procedure (Nagelkerke et al., 2009), which is usually performed for Dutch DBFM projects, and the standard DBFM contract (Rijkswaterstaat, 2009a).

Issues in the design stage of DBFM contracts are strongly related to the link with the stage of procurement. In order to secure a contract, private consortia work out designs in detail in the procurement (WB Consulting, 2009), although only outputs are requested (see section 2). This enables a better judgment of the practicalities and risks involved in the proposed solution, so that a better bid can be made. Analysis of practice reveals that this overzealous attitude of the management of consortia increases the transaction costs in procurement. Almost all the respondents from the procuring agencies and from industry see this factor as attributing to increased transaction costs.

“Overzealous questions from project organizations in long tender processes can help define competitive offers, but they can also make us go too deep, increasing costs” (private director tender division). Therefore to secure a contract in the procurement procedure, private parties have to do part of the design before the contracting. Performing private design activities before the contract is closed can have positive effects: innovation, time gains and more business-like, ‘grounded’ bids ([Van Valkenburg et al. 2008](#)). As a consequence, private parties indicate that the design activities that remain after award of the contract can be similar to the engineering component in E&C contracts: making a technical specification on the basis of a selected, worked-out design

At the design and procurement stage, instruments assess sustainability of proposed solutions and stimulate bidding parties to make their processes more sustainable. In the Netherlands sustainability of bids is assessed by the DuBoCalc instrument (Zwan et al., 2008). This quantitative instrument is characterized by a technical focus on materials and energy production. In 2012, the Dutch Ministry of Infrastructure and the Environment has introduced a CO₂ performance ladder, originally developed by Dutch railway agency ProRail (Prorail, 2010). Instead of aiming at products, this instrument assesses the working processes of potential contractors and subcontractors. These organizations can become certified at certain sustainability levels in order to get a discount on their bids. The instrument is comparable to BREEAM and CEEQUAL, applied in the United Kingdom, and the LEED system, applied in US construction industry (see for an overview Arts and Faith-Ell, 2012).

Actor dimension

Regarding the actor dimension the rather closed character of procurement, as described above, provides difficulties for cooperation between contractors and procuring authorities and for involving civil groups. Van Valkenburg et al. mentions this is inherent to the closed and confidential character of procurement (2008). In contrast to public planning procedures where the public is formally involved, in procurement procedures the public is generally not involved or only involved limitedly. Nooteboom states that a hedged, bounded space for negotiation is created that acts as a safe environment for negotiating solutions and contracts (2006). In procurement, a development towards broader, socially relevant awarding can be recognized by evaluating bids on price and quality through applying MEAT criteria (Most Economically Advantageous Tender, a requirement when applying the competitive dialogue procurement procedure see EC, 2004) and experimenting with awarding on the basis of value and cooperation.

The interviewees indicate that it is difficult to hedge of procurement in practice. A public planning manager states that it is difficult to *“keep local politicians and civil groups silent and at ease during this part of the process”*, because of their limited involvement. The public can feel excluded during a closed and confidential procurement procedure, which can fuel opposition to the implementation of the project. Public procuring authorities indicate that it is difficult to re-involve the local stakeholders in the project when procurement is successfully completed with a contract awarded. Experiences with MEAT criteria are obtained in the A12 Utrecht – Veenendaal DBFM project in which corporate social responsibility is included as one of the qualification and awarding criteria and civil groups are actively involved in judging the bids (see also Rijkswaterstaat, 2009b). The interviewees indicate that MEAT-criteria opened up possibilities for more cooperation with civil society. In addition, they mention that steps are

currently undertaken to introduce more flexible ways of procurement, such as making interviews with key experts from private contractors a part of the awarding criteria (see also Rijkswaterstaat, 2010).

Scope dimension

Lenferink et al. describe the trend to hedge the planning and procurement process by detailed public planning procedures and a strict legalistic attitude towards the actors involved in planning and procurement procedures (2010). Numerous procedural standards are involved, such as the DBFM standard contract (Chao-Duivis, 2011; Rijkswaterstaat, 2009a) and the competitive dialogue standard (Nagelkerke et al. 2010), which can restrict the flexibility regarding the scope in design and procurement. Compared to traditional contracts, contractors are supposed to have more freedom to specify the solution in DBFM contracts, because of area-oriented, context-sensitive award criteria. Such award criteria are, for example, applied in the A12 Utrecht - Veenendaal project, in which preventing traffic and environmental nuisance during construction and maintenance is one of the award criteria.

The interviewees indicate that context-sensitive award criteria can be regarded as an example of the increased attention to the relation between a project and its surroundings. The interviewees acknowledge that the project aim partly determines the flexibility for inclusiveness in the scope dimension. If the connection between functions is actively sought in a broader scope, more stakes are involved, which subsequently increases transaction costs. In line with Van [Valkenburg et al. \(2008\)](#) and [Lenferink et al. \(2010\)](#), the interviewees mention for example that the D&C contract for the A2 Maastricht project (with tunnel and urban redevelopment) is aimed at optimizing project quality and will provide the freedom to design multi-use solutions, while the Second Coentunnel and the A15 Maasvlakte-Vaanplein corridor DBFM projects are aimed at project control, and the N31 Zurich-Harlingen D&C project is aimed at achieving time gains. Although interviewees feel that the standards for procuring DBFM projects can be useful in promoting efficiency at the organizational level, they can also restrict flexibility regarding the scope at the project level: *“over-specified procurement results restrict the room for innovative designs after the contract is awarded”* (private project advisor)..

Time dimension

In the time dimension of inclusiveness ties between design and procurement help in identifying possibilities to streamline processes. By involving the market parties in both these activities, time gains can be achieved as procedures are adjusted to each other, if the start of the procurement is timed properly. Van [Valkenburg et al. \(2008\)](#) found that if market parties are approached early in the process, political uncertainties can make a project too risky for market parties to become involved in. On the other hand, if procurement is started late in relation to planning and design, political decision-making will have narrowed opportunities for market parties to effectively deal with technical-spatial issues in the project.

The interviewees mention that an inclusive perspective on the time dimension is introduced in designs and bids as life-cycle costing plays a role. In the Second Coentunnel DBFM project, for example, contractors were required to conform to ISO 15288 standards, which is a systems engineering standard covering processes and

lifecycle stages. The interviewees regard such systems as helpful, because they stimulate a lifecycle perspective. However, the interviewees are aware that systems engineering can be applied too rigidly, which does not fit the character of sustainability. Sustainability is difficult to define upfront and translate into performance targets: *“Sustainability’s fuzzy character can make it lose ground to other factors in procurement that are easier to define, such as cost and time efficiency”* (public contract manager).

5.2 Construction

The construction stage in a Dutch DBFM project has remained fairly similar to traditional contracted projects. In this stage, the contract has been awarded, the planning procedures have been completed and the political decisions have been taken. The private (sub)contractor constructs the infrastructure as specified in the contract and the public authority supervises the private activities.

Linking construction to earlier design and procurement stages is not new. As explained in section 2, there is considerable experience with D&C contracts. The danger of linking design and construction in a contract is that these activities become a black box for government, as they are no longer prepared or performed by government. Public and private parties acknowledge this as an issue because *“loss of expertise in design and construction can lead to a decrease in capability to judge quality of bids and guide following stages”* (public contract manager). This issue also is recognized in practice in the US (GAO, 2008) and in the UK, where it is related to the concept of intelligent customer (NAO, 2011). Ultimately, the loss of knowledge could affect the capacity of government to fulfill its responsibilities in infrastructure delivery and in safeguarding environmental quality. A solution is hiring external experts to judge the bids, but this increases transaction costs.

Actor Dimension

With regard to the actor dimension, room for cooperation exists in the construction stage of DBFM. Van den Brink (2009) describes how Rijkswaterstaat transforms from an inward to an outward-oriented organization: it delegates responsibilities to contractors, which requires them to change their roles and attitudes. Private contractors can stand out by improving their relationship with the environment, which is also applied in the USA and the UK (Harding et al., 2007; Ernzen and Woods, 2006). However, there is a common interest in the consortium to prevent overoptimistic designs and cost and time estimates, as can occur if mainly public actors are involved (Flyvbjerg, 2005), because profit and survival of a consortium is at stake. In addition, private consortia increasingly consist of the same combination of companies, which helps in quickly setting up efficient private-private cooperation.

Although there is considerable experience with linking design to construction in integrated contracts (see the section on D&C contracts), the interviewees indicate that the link requires attention to prevent miscommunication and misinterpretation between actors involved in design and construction. Private consortia need *“time and effort to assemble a team of designers and constructors and adjust their methods of working to each other, and to the project”* (private director tender division). Interviewees from the private parties mention that, in the

A12 Utrecht-Veenendaal DBFM project, they have to explain how they involve residents and interest groups during the construction and maintenance stages. They feel that this attention to the relation with the environment helps in raising public awareness and thereby limits the number of complaints. Involved local actors can use their expertise to positively influence the project performance. For example, *“involved municipalities in DBFM projects traditionally put more effort into the landscaping as they have to deal with local interests”* (public stakeholder manager).

Scope Dimension

Regarding the scope dimension, DBFM projects differ from traditional construction because they include a more flexible construction stage. More room is given to create smart, optimized spatial designs for the road and its surroundings, which has proven to be one of the most important innovations accomplished in the previous procurement stage (Van Valkenburg et al., 2008). More significance is given in designs to landscaping and mitigation, which results in more possibilities in the scope dimension of construction. Heeres et al. (2010) describes how smart ways to handle the connections of the project with the environment are sought through which road infrastructure projects are becoming more area-oriented. The interests included in a broader scope can be real estate, housing or nature development.

The interviewees regard area-oriented planning as a positive development. In the A12 Utrecht –Veenendaal and A15 Maasvlakte – Vaanplein DBFM projects, for example, this is applied in practice by focusing on minimizing nuisance for road users and people living in the vicinity of the project during construction. This *“stimulates synergies in the project between the included interests”* (public purchasing manager) and provides private contractors with possibilities to earn back investments. A potential issue that is recognized by the interviewees is the created interdependencies by the integrated character of DBFM projects. Small problems in one part of a project can cause delays in other parts of the project and possibly a complete standstill of a project: *“the interdependencies in a DBFM contract can make a delay cause additional delays”* (public stakeholder manager).

Time Dimension

DBFM contracts include more freedom for contractors in construction. Because only outputs are specified, contractors are free to select and choose construction methods, materials and planning. Construction can therefore be organized in a manner suited to contractors' qualities and adjusted to earlier and later stages. By doing this, also the responsibility for the project is continued after the construction stage. This changes the relations between private construction companies and causes the formation of consortia (Gruneberg and Hughes 2006).

The interviewees experience the changed character of projects and the lifecycle linkages that play a role in construction. In the past, time and costs were most important, but now *“different considerations play a role in construction, such as constructability, maintainability, and environmental quality”* (private director tender division). However, they feel that the characters and activities of consortium partners currently participating in DBFM contracts do not fundamentally change. The awarded DBFM contract is split up within consortia in separate parts for construction and maintenance, and distributed to the partners that are specialized in these activities. Therefore, life-

cycle optimizations are mainly generated in design and procurement, and play only a limited role after these stages have been completed.

5.3 Maintenance & Operation

In DBFM projects, during maintenance the contractor is made responsible for maintaining infrastructure for a certain period, usually between 15 and 30 years. The activities and investments of the private consortia are compensated for on the basis of quality of service, defined as the required availability of the road. The consortium borrows money from private financiers to finance construction and maintenance. Over the span of the maintenance stage in the contract, government pays availability fees to the contractor, the height of which depends on its performance. The fees can be adjusted for factors that negatively influence availability, such as time overruns in construction or extra lane closures for maintenance

Linking construction and maintenance is uncommon in Dutch infrastructure planning and therefore requires considerable effort. In the past, interests in maintenance were subordinate to construction. This led to conflicts between public contracting authority and private client involved in construction on the one hand, and the public maintainer on the other. However, by integrating the contract and making one consortium responsible for construction and maintenance, *“interests are aligned and collaboration is stimulated”* (private project director). Nevertheless, contrasts between large, national construction companies and smaller, often local, maintenance companies can be observed.

Actor Dimension

Aforementioned contrasts between maintenance and construction companies can provide challenges in the actor dimension. The interaction and data exchange between actors from the later stages of management and operation and earlier stages can prove to be difficult. For example, the Dutch Ministry of Finance mentions that availability fees require up-front specifications of the services to be delivered and a reliable monitoring system (2010). If data to determine these fees is available, it is subject to a great margin of uncertainty due to the time span of the contract and the complexity of society. As a consequence it is difficult to assess liability under the contract terms, which can obstruct inclusion of private actors in operation and maintenance. Therefore, in the DBFM projects for N31 Waldwei and A59 Rosmalen-Geffen, issues such as slipperiness control and incident management are performed by government (Buck Consultants and John Cooper, 2004; Province of Noord-Brabant, 2008).

The interviewees feel that expertise could be combined by involving different groups from different stages: *“existing differences in the working styles of involved private parties can even help in keeping parties sharp and alert”* (private project director), which could possibly lead to better results. However, the public and private actors that become involved in maintenance and operation of DBFM projects mention that they have to deal with contracts and agreements that were reached in earlier stages. They feel that they are *“not involved in the actual discussions and negotiations that have laid the basis for the contract”* (private operations supervisor). The interviewees agree that the performance of maintenance is subject to external factors and therefore difficult to measure and manage. Examples mentioned by interviewees are the ecological quality of verges that has proven to be difficult to measure,

and that weather conditions can influence the growth of grass between driving lanes and can make it necessary to mow them more often.

Scope Dimension

For successful lifecycle optimizations in DBFM projects, it is essential to clearly delimit project boundaries by defining an optimal period for the maintenance stage and the geographical extension of the network under consideration. Determining the span of the contract is essential for the effectiveness of this incentive. Bult-Spiering et al. describe that longer term contracts, with longer maintenance stages, include major overhaul maintenance as well as minor, periodical maintenance, and therefore play a role in determining the optimal maintenance strategy – introducing a lifecycle management approach (2005). However, such longer contracts decrease flexibility as it becomes more difficult to switch contractors when new developments require it (Buck Consultants and John Cooper, 2004). Currently, however, only relatively small parts of the road network are contracted out through DBFM contracts (Roohé, 2007). The small size of the A59 DBFM project, for example, limited profitability of maintenance and caused the public party to take control of some management tasks (Habets, 2010).

Interviewees from the public organizations indicate that, during maintenance, strategic organizational issues will play a role, in which it can be difficult to distinguish between temporal tasks to be included in the scope of the project and other tasks that are part of the strategic organization of the road network. With increasing application of DBFM contracts, more maintenance of parts of the road network is delegated to private parties, resulting in a fragmented picture. From an asset management point of view, integration over projects stages can be outbalanced by disintegration of network management. An interviewee mentions that “[it can be more profitable to] *manage the complete road network instead of locking-up parts of the network in DBFM contracts, in order to make maintenance optimizations over the whole network*” (public contract manager).

Time Dimension

DBFM contracts offer possibilities for applying lifecycle optimizations in construction and maintenance, which traditionally had to be laid down in separate warranty regulations for construction and for maintenance. As Bult-Spiering et al. (2005) and Van Garsse et al. (2009) recognize balancing maintenance and construction costs can lead to optimizations over the total project lifecycle. However, DBFM contracts are often set up in detail (see section 5.1) and there are no strong incentives to increase the adaptability and resilience of project elements. For public parties, contractual long-term commitment to a private partner can restrict options for new strategic plan-making, as also recognized in Belgian DBFM practice (see Van Garsse et al., 2009), and can create tensions with operation activities, such as dynamic traffic flow management. Different parties are responsible for maintaining (private) and operating (public) infrastructure, with different objectives and primary goals.

Interviewees experience tensions between maintenance and operation, partly as a result of excluding operation from Dutch DBFM contracts. While maintenance aims at quality of infrastructure, operation at quality and quantity of transport. They feel that the two tasks need to be continuously coordinated, which lead to detailed regulations and contracts that negatively affect the room for flexibility and the possibilities to increase sustainability.

In addition, changes will occur over time and limitations with respect to the scope and adaptability of DBFM contracts will make themselves felt: by the end of the maintenance period the infrastructure will differ significantly from the project as laid down in the contract. For example, an interviewee mentions that “*due to rapid developments in the field of electronic installations and dynamic traffic flow management, existing techniques might outdate quickly*” (public contract manager). However, interviewees generally feel that these possible disadvantages can be outweighed by advantages of integrating several stages in a contract: “*a consortium can reduce maintenance costs by adjusting the construction and perform lifecycle optimizations in the design*” (public technical manager).

6. CONCLUSIONS AND DISCUSSION: TOWARDS INCLUSIVENESS IN DBFM CONTRACTS

In order to determine the influence on inclusiveness, a process-based perspective was adopted, in which inclusiveness is investigated. In the previous section issues in various stages of integrated projects were discussed, which can limit or enhance inclusiveness (see Table 2).

<Insert Table 2 around here>

6.1 Conclusions: Sustainable life-cycle integration in contracts

We can conclude that the extent to which integration of stages in DBFM contracts can contribute to more inclusive Dutch road infrastructure projects determines on the character of a project and the attitude of the actors involved. Public and private experiences with lifecycle integration in DBFM projects are positive: linkages included in the contract enable lifecycle optimization as procurement and design, construction and maintenance are adjusted to each other. However, the interviewees also bring forward critics and limitations of DBFM projects in the investigated actor, scope and time dimensions, which illustrate that there is still considerable room for improvement project management to come to more inclusive infrastructure development.

With regard to the *actor* dimension, it can be concluded that the integration of stages in DBFM contracts improves relations between actors because interests are aligned with a shared common goal within the contract and consortium. However, the closed character of procurement can obstruct the involvement of public and local government, also in later stages. The broader socially relevant award criteria set in procurement can help improve inclusiveness in the actor dimension of a project’s design, construction and maintenance by facilitating relations between government, market parties and civil society. In the *scope* dimension, DBFM stimulates integrated designs and can help achieve sustainable synergies. However, this might be obstructed in practice by detailed inflexible procurement which limits freedom in adjusting scope. Furthermore, in later operation and maintenance stages tensions between the tasks and the responsibilities included in the project and the wider network oriented asset management tasks can emerge. Context-sensitive award criteria, designs and maintenance strategies can help strengthen the relation between infrastructure and surrounding environment. Regarding the *time* dimension, DBFM contracts prove to enhance interaction between stages. Integrated DBFM contracts can lead to more inclusiveness through lifecycle optimizations, inspired by lifecycle costing in procurement and lifecycle management in later stages.. However, interviewees bring forward issues that arise in defining desired performance rigidly at an early

stage and measuring it afterwards. In addition, in Dutch integrated DBFM projects, operation is disconnected from the other stages, thereby limiting the incentive to perform lifecycle optimizations that relate to operation of infrastructure and connect to plan-making and help to deal with the interfaces between infrastructure project and infrastructure network

All-in-all, it can be concluded that integrating stages of road transport infrastructure projects may be a logical step towards sustainable performance in the lifecycle, which can be facilitated by DBFM contracts. The framework with three dimensions of inclusiveness provides a relevant addition to evaluative research on road infrastructure contracts, which is mainly based on project outcomes (see [Hodge and Greve, 2009](#)) and technically measurable sustainability of delivered products. It allows the adoption of a more inclusive process perspective, which is relevant to project management (see [Söderlund, 2002](#); [Cicmil et al., 2006](#)). However, in order to achieve sustainability, a connection needs to be made between the process-oriented and the product-oriented streams in project management. In that respect, it must be noted that this research is limited to Dutch DBFM contracts, while in practice, more types of public private arrangements exist that can offer sustainability in process and product through lifecycle optimizations and experiences can differ across countries (e.g. other types of contracts such as DBFMO or alliances, and other roles for public and private parties). Further research could be aimed to include these experiences from other countries.

6.2 Recommendations: Strategies for improving sustainability

Based on the insights provided in this article, we can recommend to pursue three promising avenues for project management research to further increase inclusiveness: green procurement, strategic asset management and relational contracting

The first avenue of green procurement relates to the time dimension. Green procurement is defined as guaranteeing and encouraging sustainable construction in the processes of drawing up contracts (Commission of the European Communities, 2004; [Russel, 1998](#)) by determining sustainable qualification, award and contract performance criteria during procurement, the stage at which project boundaries are set for later stages.. These criteria provide private market parties with public wishes and ambitions that exceed the project preconditions and therefore stimulate private parties to feel responsible for a project beyond the standard performance. Green procurement is applied in several countries: in Canada as green procurement (PWGSC, 2006) and in the USA as environmentally preferable purchasing or green purchasing (US Environmental Protection Agency, 2010). The development and application of MEAT criteria in project management can be seen as a first step along this avenue, but this could be further integrated into sustainability measurement systems, such as LEED, BREEAM, CO₂ performance ladder and CEEQUAL ([Arts and Faith-Ell, 2012](#)).

The second avenue relates to the scope dimension as it involves a reconsideration of the relationship between DBFM contracts, at the project level, and asset management, at the network level. Strategic asset management is *'a business process and a decision-making framework that covers an extended time horizon, draws from economics as well as engineering, and considers a broad range of assets'*(FHWA, 2011). By effectively linking back the maintenance and operation stages (asset management and traffic management) to the policy-making

and plan-making stages, the lifecycle can be completed. Simply implementing a neo-liberal agenda of transferring tasks and responsibilities from public to private sector will not suffice. Applying strategic asset management in project management involves a redefinition of the role of government and market parties.

A third avenue relates to the actor dimension and involves the recognition that neoclassical discrete contracts, like DBFM, may not sufficiently adapt to changing circumstances because they are aimed at completeness (Williamson, 1979; Hillman, 1997). Long-term contracts have to account for that by incorporating open-ended terms, which leave a margin for variation or complete renegotiation of commitments. Efficient contracting must therefore be cooperative and based on trust, not on obligations specified in advance (Campbell and Harris, 2005). Introducing relational contracts could make project management more adaptive and resilient in order to cope with complexity and bridge implementation gaps. Relational contracts have parties create unique, interdependent relationships between public and private actors, which are suitable for complex projects (Cheung et al., 2006; Turner and Simister 2001), because they help improve relationships and smoothen difficulties in the transaction (Rahman and Kumaraswamy, 2008). A first step is made in project management by introducing arrangements such as partnering, strategic alliancing, project alliancing and joint ventures (Chan et al, 2010).

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