Publiek-Private Samenwerking in de Transportinfrastructuur Resulteert in Betere Uitkomsten: Wens of Waarheid?[1]

Dr. Stefan Verweij – Rijksuniversiteit Groningen, Basiseenheid Planologie – s.verweij@rug.nl
Dr. Ingmar van Meerkerk – Erasmus Universiteit Rotterdam, Afdeling Bestuurskunde en Sociologie – vanmeerkerk@essb.eur.nl

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Samenvatting[2]

Het idee is dat door transportinfrastructuur te ontwikkelen via Publiek-Private Samenwerking (PPS) er een betere performance wordt bereikt dan infrastructuurontwikkeling zonder PPS. Zo zou PPS resulteren in lagere projectkosten en een snellere projectrealisatie. Argumenten zijn dat de private sector beter in staat zou zijn om risico's te managen en dat PPS-contracten prikkels bevatten voor de private partner om projecten zonder kosten- en tijdsoverschrijdingen op te leveren. Echter, het bewijs voor de betere performance van PPS is beperkt. Zo zijn berekeningen van de performance vaak gebaseerd op ex-ante uitkomsten en moet het dus nog maar blijken of gewenste uitkomsten ook materialiseren. Daarnaast hebben claims van een betere performance regelmatig een anekdotisch karakter en zijn ze veelal gebaseerd op enkelvoudige casusstudies. Het roept de vraag op of betere uitkomsten via PPS meer wens of waarheid zijn. In deze bijdrage gaan we in op die vraag.

Dat doen we door een analyse van de performance van 65 Nederlandse transportinfrastructuurprojecten. We analyseren twee performancevariabelen: kosten en tijd. Daarbij maken we steeds een vergelijking tussen Design-Build-Finance-Maintain (DBFM) projecten – een typische vorm van PPS – en projecten met een Design-and-Construct (D&C) contract. Is het inderdaad zo dat DBFM-projecten minder meerwerkkosten kennen in de realisatiefase dan D&C-projecten? Bij meerwerk gaat het om additionele projectkosten nadat het contract tussen opdrachtgever en opdrachtnemer is gesloten. En is het inderdaad zo dat DBFM-projecten minder tijdsoverschrijding kennen dan D&C-contracten? Hierbij gaat het om de tijdswinst of –verlies die optreedt in de realisatiefase van het project.

De analyse laat zien dat DBFM-projecten gemiddeld 6,24% additionele projectkosten hebben als percentage van de initiële contractwaarde (N= 9) en dat bij D&C-projecten dit percentage significant hoger is met 24,72% (N = 48). DBFM-projecten doen het dus beter als het gaat om kostenbeheersing. De analyse laat verder zien dat, hoewel DBFM-projecten gemiddeld een lagere tijdsoverschrijding hebben dan D&C-contracten, deze verschillen tussen DBFM en D&C niet statistisch significant zijn. We concluderen dat PPS inderdaad resulteert in betere uitkomsten, vooral wat betreft kosten. Waarheid dus.

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1. Introduction

Public-Private Partnerships (PPPs) are popular with policymakers (Bovaird, 2004), particularly for the development and management of transport infrastructure such as highways, railways, and waterways (Kwak et al., 2009; Little, 2011). In Europe, transport is invariably the largest PPP-sector in value terms (European PPP Expertise Centre, 2016, 2017, 2018). Core motivations to opt for PPPs have been the off-balance sheet financing of infrastructure projects which reduces the borrowing and budget constraints for governments, the transfer of risks to the private sector, and the increase of efficiency and effectiveness of infrastructure development and management (McQuaid and Scherrer, 2010; European PPP Expertise Centre, 2015) in terms of cost and time savings (e.g., Commissie Private Financiering van Infrastructuur, 2008). These advantages are supposedly achieved because, inter alia, PPP-projects have strong in-built mechanisms that curtail principal-agent problems. The contracts incentivize the private partner to develop projects on-time and to not claim additional costs after the project implementation has started. However, the evidence for the increased performance of PPPs has remained mixed and contested (Hodge and Greve, 2009, 2017). It is therefore important that PPPs are studied and assessed "away from the policy cheerleaders" (Hodge and Greve, 2007, p. 545).

A major reason for the weak evidence-base is that the outcomes of PPP-projects are generally evaluated ex-ante, using methods such as the public sector comparator (Grimsey and Lewis, 2005; Boardman and Hellowell, 2017). For instance, the Dutch Ministry of Finance estimates that DBFM(O)-projects (a type of PPP), compared to traditionally procured projects, achieve prospected cost advantages – in terms of value-for-money – ranging from 10 to 15% (Ministerie van Financiën, 2016). A shortcoming of this focus on prospected outcomes is, however, that it is unclear whether the outcomes actually materialize (Boers et al., 2013). For instance, low bids on contracts may evaporate due to contract claims during project construction (Mohamed et al., 2011). The weak evidence-based is exacerbated by the fact that PPP-research is dominated by single case studies (Tang et al., 2010); this means that the claimed increased performance of transport infrastructure development and management through PPPs is often based on anecdotal or single case study evidence (Bovaird, 2010). Therefore, more research is needed into the actual outcomes of PPPs (Torchia et al., 2015), beyond single case studies, that focusses on the difference in performance between PPP-projects and non-PPP-projects. This paper addresses this research gap.

We analyze the cost and time performance of 65 Dutch transportation infrastructure projects. The data concern the actual outcomes in the implementation phases of the projects (i.e., after the shovel has hit the ground). The analysis focusses on the comparison between projects with a Design-Build-Finance-Maintain (DBFM) contract and projects with a Design-and-Construct (D&C) contract. Although both types involve contract designs where the private partner is integrally responsible for the design and construct of the transport infrastructure, DBFM is generally considered a type of PPP whereas D&C is not (Yescombe, 2007, 2013). The reason is that private project financing, an essential element of PPPs, is present in DBFM but not in D&C. Although D&C-contracts can be a subcontract in DBFM-projects, they are generally not considered PPPs by themselves (Yescombe, 2007, 2013).

In Section 2, we will continue by developing a set of hypotheses, rooted in principal-agent theory, that argue why DBFM would perform better in terms of cost and time

performance than D&C. This theory provides a useful lens for the present study, because DBFM-projects involve typical principal-agent relationships (Klijn, 2010). The reason is that both principal-agent relationships and public-private relationships in transport infrastructure projects are characterized by (1) a separation of ownership of the infrastructure and the right to maintain and operate it, (2) information asymmetry between the public and private actors, (3) different interests, and (4) uncertainty due to the long time span of the relation (Liu et al., 2016). In Section 3, the data collection and methods are explained. Section 4 presents the results of the analysis. In Section 5, the conclusions are drawn.

2. Hypotheses

2.1 Background: Principal-Agent Problems

A major motivation to opt for a PPP in the development and management of transport infrastructure is the transfer of project risks to the private sector. The idea is that by involving the private sector, project risks that were traditionally borne by the government are now allocated to a private partner, under the assumption that the private sector is better able to manage those risks. The public and private sectors are governed by different value systems – that is, they have fundamentally different perspectives, interests, goals, and practices (Jacobs, 1992) – and these differences may allow for positive synergies to arise, resulting in increased project quality and efficiency (Huxham and Vangen, 2000).

However, the increased involvement of the private sector also adds new risks, namely: risks associated with the contractual arrangement between the public and private partners (De Palma et al., 2009). That is, the differences between the public and private sectors can also lead to negative outcomes when the partners choose to pursue their self-interests at the expense of the shared project interests (De Palma et al., 2009). Whereas the public sector serves the public interest, a private consortium strives to maximize his own profits (De Bettignies and Ross, 2010). This, then, concerns the principal-agent problem of PPPs: while the involvement of the private sector "off-sets procurer cost burdens, it also puts the private partner in significant control of the whole project, inviting actions that siphon off benefits to themselves at the cost of the procurer, whose interests they are supposed to serve" (Shrestha and Martek, 2015).

The private partner (the agent) is able to serve his self-interests at the expense of the public partner's (the principal) interests because their relationship is characterized by an asymmetry of information, where the agent is better informed than the principal (De Palma et al., 2009; Shrestha and Martek, 2015). First, the private partner has more information about his own competences and skills. This may lead to the problem of 'adverse selection' by the public partner (ex-ante, pre-contract), where he selects an agent that is not the best one for the project (Shrestha and Martek, 2015). It may also lead to the situation where the public partner is unable to observe the competences and skills of the private partner as they are being put to use in the project (ex-post, during implementation) (De Palma et al., 2009). Second, the private partner has more information about the project's internal and external risks (De Palma et al., 2009). This may lead the agent to act opportunistically when he decides to deliberately misrepresent the risks and the measures required to mitigate them (Liu et al., 2016; Fernandez et al., 2018). This is referred to as the problem of 'moral hazard' (Shrestha and Martek, 2015). It may become visible in contractors falsely claiming additional costs after the project implementation has started (Mohamed et al., 2011).

Principal-agent theories explore the governance mechanisms that aim to regulate the self-serving behavior of the agent (Bovaird, 2010). For PPPs, these mechanisms focus on: the contract specifications, the monitoring of the agent's performance, and the performance-dependent payment (De Palma et al., 2009; Leruth, 2012; Reynaers, 2015). These mechanisms, however, may also be found in projects that are generally not considered PPPs, such as projects with D&C-contracts. First, contracts should be complete, fully specified, and stable over time. This decreases uncertainty and project information asymmetry between the partners, thus curtailing the problem of moral hazard. At the same time, a certain extent of incompleteness is needed, under the assumption that this allows the private partner to fully use his competences and skills to plan and design the project (Reynaers, 2015). If the contract is fully specified, these competences and skills are underused. Moreover, a certain degree of contract flexibility may also allow incorporating possible contract changes. This reduces possibilities for moral hazard to occur, resulting in less claims that would otherwise have led to additional costs (Fernandez et al., 2018). Second, monitoring increases the public partner's information about the agent's competences, skills, and performance. This can curtail the problem of adverse selection. To this end, it is important that the output indicators in the contract are measureable and that the public partner has access to performance data (De Palma et al., 2009). Because extensive contract monitoring easily leads to increased ex-post transaction costs (Carbonara et al., 2016), in PPP-projects the principal often 'monitors from a distance' using e.g., system-oriented contract management (Rijkswaterstaat, 2014). Third, performance-dependent payment means that the private partner is financially fined (or rewarded) by the principal based on his performance, which incentivizes him to perform well. It relates to the mechanism of 'credible punishment' where the principal fines the agent when he cheats, incentivizing him to not act opportunistically (De Palma et al., 2009). The mechanisms introduced here may be found in both DBFM- and D&C-contracts. The next two subsections therefore focus on specific differences between the two contract types.

2.2 DBFM versus D&C: Cost Performance

In D&C-contracts, the risks associated with the design and build (construction) of the transport infrastructure are transferred to the private sector; in DBFM, additionally, the maintenance risks are also transferred (Culp, 2011). It is argued that the increased transfer of risks leads to efficiency gains in the presence of significant 'economies of scope' which means that the bundling of design and build with maintenance leads to better designs that in turn require less maintenance costs (Martimort and Pouyet, 2008; Moore et al., 2017). Because improved designs may require learning new procedures for project construction and maintenance that may actually increase costs (Martimort and Pouyet, 2008), we expect to find DBFM-contracts mainly in larger projects.

In both D&C and DBFM, the ownership of the infrastructure in the end remains with the public partner who pays for the project design, construction, and in the case of DBFM also the maintenance. However, in DBFM the project activities are (at least in part) privately financed (Culp, 2011). A single purpose entity, also known as the Special Purpose Vehicle (SPV), is set up that consists not only of contractors but also banks and/or investors (Ng and Loosemore, 2007). The SPV uses contracts secondary to the concession contract (i.e., the public-private contract), to finance the project through (short- and long-term)

loans and subcontracts for the design, build, and maintenance of the project (Ng and Loosemore, 2007; Demirag et al., 2011).

Because governments have clear financing cost advantages over private consortia (governments can normally borrow money against lower interest rates) (Leruth, 2012; Moore et al., 2017), this again means that we expect to find DBFM-contracts mainly in larger projects. DBFM requires a certain project size to be a viable option. In the Netherlands, DBFM is thus normally only considered for projects over €60 million (Ministerie van Financiën, 2013). There are several reasons why the private financing in DBFM is expected to lead to better cost performance compared to projects with a D&C-contract.

First, in DBFM risks related to design, construction, and maintenance are allocated to the private partner (De Palma et al., 2009). Therefore, additional work that stems from these risks may have to be financed by the private partner. Naturally, risks related to inter alia project specification, force majeure, and changing principal demands remain with the public partner (De Palma et al., 2009). The privately financing of the additional work increases uncertainty ('will the financiers provide the loan?') and transaction costs for the private partner. He will therefore try to minimize additional work that would lead to increased costs. The business model in DBFM focusses on finding innovative and efficient solutions through integrated project designs and processes and life-cycle optimization (Lenferink et al., 2013). In D&C-contracts, in contrast, additional work is not privately financed. This means that the uncertainty and transaction costs associated with privately financing additional work are absent. Instead, claiming additional work at the expense of the public partner may increase the private partner's revenue and potentially his profit. This may lead the private partner to act opportunistically (Mohamed et al., 2011), i.e., to use his informational advantage and claim additional work at the principal's expense as part of his, so to say, 'business model' (the problem of moral hazard).

Second, the equity provider in DBFM, who finances the activities of the private consortium, "provides an added level of diligence for effective project execution" (Culp, 2011, p. 237). Financiers are risk-averse and they will place high demands on sound, high-quality risk management for them to provide the loans and invest in the project (Demirag et al., 2011). The idea is that this leads to a better identification, allocation, and mitigation of risks. Practitioners sometimes refer to this effect of private financing on risk management as 'the shadow of the banks' (own correspondence). The assumed improved risk management decreases uncertainty and risks, leading to less additional work hence costs. It also means that the private partner is forced to explicate his risk management plan during the tendering phase of the project, explicating its risk management competences and skills, thereby decreasing the problem of adverse selection. The effect of the shadow of the banks is absent in projects with a D&C-contract. Because of these two reasons, our first hypothesis is:

H1. DBFM-projects have better cost performance (i.e., less additional work costs) than D&C-projects

2.3 DBFM versus D&C: Time Performance

Performance-dependent payment is an essential element of PPP-projects. In many DBFM-projects, the private partner finances the project and receives payments from the public partner only when the project is fully constructed (Culp, 2011). Additional project

milestones at which he receives payments, however, may also be defined (e.g., Verweij, 2015). When the construction phase is finished, the transport infrastructure is in full use again and the SPV continues to receive a stream of payments from the public partner for infrastructure maintenance for a period of normally 20-30 years (Yescombe, 2007). Importantly, the private partner's revenue structure is highly dependent on the payment stream from the public partner (Ng and Loosemore, 2007). When he fails to comply with the output specifications agreed in the contract, he may be fined and cut short on his payments (Demirag et al., 2011). Moreover, when he fails to meet important milestones (deadlines) agreed with the public partner, he may also be fined or his payments are delayed. Because the project financing consists of multiple short- and long-term loans, he consequently may not be able to meet his debt service obligations. This will have a negative effect on his creditworthiness and his profits may decrease (Ng and Loosemore, 2007). In D&C-contracts, the business model relies to a much lesser extent on meeting the deadlines. Therefore, our second hypothesis is:

H2. DBFM-projects have better time performance (i.e., less delay in finishing project construction) than D&C-projects

3. Data and Method

3.1 Data Collection

The data were collected between April and July 2018 from the Project Database of Rijkswaterstaat. Rijkswaterstaat is the executive agency of the Ministry of Infrastructure and Water Management and it is the major procurer of highway and waterway transport infrastructure in the Netherlands. Access to the data was allowed under the condition that it was anonymized and that results are not traceable to specific projects or persons. By collecting and analyzing actual project management data (instead of interview or survey data), this contributes to the evidence-based management of projects and the practical relevance of the study.

The database contained 298 highway-related cases. Data on waterway-related projects were not collected. After deleting cases that were not infrastructure projects – i.e., that did not include infrastructure construction (e.g., programs, small measures such as road signage placements or sound barriers, and innovation projects) – and that were devoid of data, 72 projects remained. Subsequently, seven projects were excluded. One project did not contain data on costs and time. One project concerned a calamity project that had not gone through a normal procurement and decision-making process, one project did not include a construction contract yet, two projects concerned traditional Design-Bid-Build contracts (in Dutch: RAW-contracts), and for two projects the contract type was not available or unclear.

From this point onwards, the analyses proceed with the remaining 65 projects.[3] Nine projects have a DBFM-contract (14%) and 56 projects have a D&C-contract (86%). The oldest project by implementation start commenced in February 2008 and the most recent project by implementation start commenced in April 2017. Because DBFM only started to take off in the Netherlands since 2007 (Eversdijk and Korsten, 2015), because D&C is the standard form of contracting by Rijkswaterstaat (Lenferink et al., 2013), and because

[3] Significant efforts were made to retrieve missing data. However, some projects still have missing data, which leads to a different N for different analyses.

DBFM is only considered for large or very large projects (see next section), this explains the larger share of D&C-contracts in the dataset and the relatively small number of DBFM-contracts.

3.2 Data Measurement and Analysis

The analyses focus on four variables: cost performance in k€, time performance, contract type, and project size. *Cost performance* is measured as: the value in k€ of the sum of the additional work costs after the closure of the D&C/DBFM contract(s), divided by the value of the contract(s), resulting in a percentage. Some projects involve multiple contracts (hence the plural). As an example, one project with a contract value of k€1,386.914 (i.e., over €1.3 billion) and additional work with costs of in total k€168,434 has a cost performance of 12.14%. Higher percentages indicate a higher cost overrun and thus a lower cost performance.

Time performance is measured as follows. The number of days between the start of the implementation phase and the full recommissioning of the infrastructure after completion of the construction works equals the actual length of the implementation phase.[4] By subtracting this number from the planned length of the implementation phase, this gives the implementation delay in days. In the example of the above-mentioned project, the implementation started on April 25th 2011 and the infrastructure was fully recommissioned on April 29th 2016. The actual length of the implementation phase is thus 1804 days. Because the recommissioning was planned on December 1st 2015 (i.e., a planned implementation phase of 1656 days), the delay was 148 days. Dividing this delay by the planned implementation duration (i.e., 148/1656), this gives a time performance of 8.94%. Higher percentages express higher time overruns and thus a lower performance. We note that we calculated the relative time performance for different moments in time. First, we calculated the time performance for the recommissioning date as planned at the time of the contract award. We indicate this as the 'Relative Time Performance T=0'. Over the duration of implementation, however, scope changes may occur (Verweij et al., 2015) that lead to an adjustment of the planned recommissioning date. Therefore, secondly, we also calculated the time performance for the recommissioning date as planned measured at March 2018. We indicate this as the 'Relative Time Performance 2018-T1'.

The *contract type* is a binary variable: D&C or DBFM. The analyses focus on the comparison of projects with a DBFM-contract with projects with a D&C-contract. As explained in Section 2.2, DBFM-contracts are mainly found in larger projects. Therefore, we also include *project size* as a variable. Project size is measured as the value of the contract(s) of the project at the moment of contract closure, i.e., the initial contract value of the project. We performed analyses for three different sets. In the first set – which we coin the 'all-inclusive set' – project size is not accounted for and the full group of 56 D&C-projects is compared to the full group of 9 DBFM-projects. In the second set – which we coin the 'Rijkswaterstaat policy set' – only projects above €60 million are compared, resulting in a group of the DBFM-projects and D&C-projects with a project size of ≥ €60 million. The logic behind this set is that DBFM is normally only considered for projects over €60 million (Ministerie van Financiën, 2013). Therefore, it makes sense to compare in particular the D&C-projects above €60 million with the DBFM-projects (which are always

[4] For D&C-contracts, the start of the implementation phase is marked by the milestone "shovel in the ground" in the Project Database. For DBFM-contracts, it is marked by the "date of commencement" on which the private partner receives the starting certificate.

above €60 million). The third set – which we coin the 'empirically-informed set' started with the clusters as defined by Cantarelli et al. (2012; see also Verweij et al., 2015) in their analysis of cost overruns in Dutch transport infrastructure projects: small projects [< €50 million], medium projects [€50 million < €112.5 million], large projects [€112.5 million < €225 million], and very large projects [> €225 million]. Then, since we observe DBFM-projects only within the large and very large groups (i.e., > €112.5 million), we decided to run the analysis for this set only for projects above €112.5 million, in order to compare projects which are, based on their actual size, more equal.

4. Results

4.1 Descriptive Statistics

In Table 1, the means and standard deviations for project size, cost performance (in absolute and relative values), time performance (in absolute days and relative delays), and project completeness are presented. Here, we only present the statistics for the 'all-inclusive set' because of the limited space available. In general, looking at the mean scores, DBFM-projects perform better both for cost and time performance. That is, we observe that the average relative cost performance is 6.24% in DBFM-projects and 24.72% in D&C-projects. This means that DBFM-projects have, on average, additional work costs of 6.24% of the initial contract value, whereas the average relative increase in costs due to additional work in D&C-projects is almost four times higher. This finding is in line with previous analyses (Verweij et al., 2015). Regarding the time performance for the recommissioning date as planned at the time of the contract award (T=0), we observe that DBFM-projects have, on average, a delay of -11.79% of the planned duration of the implementation phase, i.e., an acceleration of the implementation phase. The average time performance is almost 5% higher, at 16.67%, when changed planned dates for the recommissioning of the infrastructure due to scope changes are taken into account (2018-T1). It can be seen in the table that the time performance for D&C-projects is lower.

Finally, project completeness expresses the percentage of completion of the implementation phase at the moment of data collection. There are five projects which have not fully finished the construction phase yet: two DBFM-projects and three D&C-projects. Since the differences, regarding the relative cost performance, between the projects with a 100% completeness and the projects with a lower completeness were not significant, we decided to include them in the analysis. Concerning time performance, these projects are of course missing cases.

The descriptive statistics show that the standard deviations in both sets (DBFM and D&C) are generally high. Hence, there is quite some variation within both sets. This holds especially for the set with D&C-projects regarding the relative cost performance (as compared to the DBFM-projects).

Contract Type	**DBFM**	**D&C**	**Total**
Project Size (k€)	N = 9	N = 49	N = 58
Mean	631,427.67	75,900.45	162,102.95
SD	576,336.89	92,262.55	308,147.03
Absolute Cost Performance (k€)	N = 9	N = 49	N = 58
Mean	60,480.33	17,100.41	23,831.78
SD	87,646.23	24,199.96	42,688.97
Relative Cost Performance (%)	N = 9	N = 49	N = 58
Mean	6.24	24.72	21.85
SD	5.80	24.32	23.42

Absolute Time Performance T=0 (days) Mean SD	N = 6 -164.67 547.95	N = 31 12.35 320.93	N = 37 -16.35 363.19
Absolute Time Performance 2018-T1 (days) Mean SD	N = 7 -151.71 99.59	N = 33 -59.55 225.12	N = 40 -75.68 210.64
Relative Time Performance T=0 (%) Mean SD	N = 6 -11.79 30.77	N = 31 1.20 57.34	N = 37 -.09 53.8
Relative Time Performance 2018-T1 (%) Mean SD	N = 7 -16.67 11.31	N = 34 -6.02 52.63	N = 41 -7.83 48.17
Project Completeness (%) Mean SD	N = 9 86.74 27.24	N = 56 96.62 14.59	N = 65 95.25 16.95

Table 1: Descriptive Statistics for all DBFM and D&C Projects (N ranging from 37 to 65 depending on data availability)

4.2 Cost Performance

To make a more nuanced comparison between the DBFM-projects and the D&C-projects, we constructed the three different sets as introduced in Section 3.2. The data are not normally distributed: in the all-inclusive set, the Shapiro-Wilk test is significant for the D&C-group (.00) but not for the DBFM-group (.14). We therefore used the non-parametric Mann-Whitney U test. This test has the advantage that it does not assume equal variance within groups or assume equal sample sizes. The results are presented in Table 2.

Contract type	**DBFM**	**D&C**	**Significance Difference? (Score)**
Set 1: All-Inclusive *Mean*	N = 9 *6.24*	N = 49 *24.72*	*Yes (.007)*
Set 2: Rijkswaterstaat Policy (D&C-projects ≥ €60 million) *Mean*	N = 9 *6.24*	N = 18 *27.19*	*Yes (.005)*
Set 3: Empirically-Informed (D&C-projects > €112.5 million) *Mean*	N = 9 *6.24*	N = 11 *24.27*	*Yes (.007)*

Table 2: Comparative Group Analyses (Mann-Whitney U Test) for Relative Cost Performance (%)

The results show that, for all three sets, the difference between the DBFM-projects and the D&C-projects for relative cost performance is statistically significant. In fact, the mean scores across the three analyses with different project size sets for the D&C-contracts does not differ much. Hence, we can conclude that, although both DBFM- and D&C-projects have cost overruns, DBFM-projects perform better than D&C-projects. We therefore confirm the first hypothesis (H1).

4.3 Time Performance

Table 3 shows the results for the differences in time performance (both for T=0 and 2018-T1). Again, we opted for the non-parametric Mann-Whitney U test because the data on this variable are also not normally distributed. This holds in particular for the D&C-group, for which the Shapiro-Wilk test is significant for both T=0 and T=1 (.00/.00), whilst it is not significant for the DBFM-group in the all-inclusive set (.24/.51). The results are presented in Table 3.

The analyses show that, for all three sets, the differences between the DBFM-projects and the D&C-projects for relative time performance (for both T=0 and 2018-T1) are not statistically significant. We therefore cannot confirm the second hypothesis (H2). We do observe that the differences between DBFM and D&C in the 'Rijkswaterstaat policy set' and the 'empirically-informed set' approximate significance, in particular for the 2018-T1

values. DBFM-projects seem to have a better time performance, although we have to stress that the difference in mean scores is not significant.

Contract Type	DBFM	D&C	Significance Difference? (Score)
Set 1: All-Inclusive Time overrun (%) T = 0 *Mean*	N = 6 *-11.79*	N = 31 *1.20*	 *No (.302)*
Set 1: All-Inclusive Time overrun (%) T = 1 *Mean*	N = 7 *-16.67*	N = 34 *-6.02*	 *No (.186)*
Set 2: Rijkswaterstaat Policy (D&C-projects ≥ €60 million) (T=0) *Mean*	N = 6 *-11.79*	N = 12 *10.36*	 *No (.125)*
Set 2: Rijkswaterstaat Policy (D&C-Projects ≥ €60 million) (2018-T1) *Mean*	N = 7 *-16.67*	N = 12 *0.74*	 *No (.068)*
Set 3: Empirically-Informed (D&C-projects > €112.5 million) (T=0) *Mean*	N = 6 *-11.79*	N = 7 *13.57*	 *No (.181)*
Set 3: Empirically-Informed (D&C-projects > €112.5 million) (2018-T1) *Mean*	N = 7 *-16.67*	N = 7 *6.26*	 *No (.073)*

Table 3: Comparative Group Analyses (Mann-Whitney U Test) for Relative Time Performance (%)

5. Conclusions and Discussion

At the outset of this paper, we asked the question whether the prospected advantages of developing and managing transport infrastructure through PPPs actually materialize. Does DBFM live up to its high expectations? Based on our analyses, we conclude that DBFM-projects indeed perform significantly better than D&C-projects with respect to costs (cf. Verweij et al., 2015). With respect to time performance, we cannot conclude that either DBFM- or D&C-contracts perform better than the other.

A closer look at the data shows that the average relative cost performance of the DBFM-projects in our dataset is 6.24%. This means that additional work that occurred after the contract was concluded, has led to increased project costs for the public partner of 6.24% of the initial contact value. Although the cost advantage of DBFM over D&C speaks in favor of developing and managing transport infrastructure through PPPs, this cost increase in DBFM is a reason for concern. That is, the advantage of DBFM over D&C notwithstanding, ex-ante evaluations by the Dutch Ministry of Finance (2016) produced cost advantages of 10-15%, but our analysis shows that this advantage largely evaporates once projects have started. As we hypothesized, the private financing in DBFM indeed seems to provide a strong incentive for the private partner to not act opportunistically by claiming additional work costs after the shovel has first hit the ground. However, DBFM is not fully immune to the problem of moral hazard. It is therefore imperative that the search for improved design and management of DBFM-contracts continues. We offer a few recommendations and avenues for future research.

First it has to be acknowledged that contracts, performance monitoring, and performance-dependent payments are not beatific. Sure, in an ideal world, fully specified and complete contracts may cancel out the opportunistic behavior of the private partner (Hart, 2003). In the real world, however, contracts are incomplete by definition (Badenfelt, 2011). Furthermore, increasing the private partner's proportion of the benefits generated in the PPP may decrease his incentive to act opportunistically (Liu et al., 2016). In Dutch DBFM-projects, however, this may be difficult to achieve because the revenue is rooted in

availability-based payments instead of usage-based payments (e.g., toll fees) (Yescombe, 2007).

Although contracts are of indisputable importance in limiting principal-agent problems, their significance should thus not be overstated. Recent studies indicate that the contract characteristics of PPPs explain the performance of PPPs to only a limited extent (Klijn and Koppenjan, 2016) or not at all (Kort and Klijn, 2011). Instead, process management and relational aspects seem to be more important for PPP-performance (Kort and Klijn, 2011), although recent studies show that it is the correct mix of contractual and managerial aspects that matters (Kort et al., 2016). The interaction between the both aspects is thus a valuable research avenue to pursue (Verweij, 2018).

Our analysis has not focused on the reasons behind the costs associated with the additional work. A previous study indicated, for instance, that scope changes are the most common reason for additional work in the implementation phase and that smaller projects are particularly subject to additional costs due to contract omissions (Verweij et al., 2015). However, that study did not distinguish between DBFM- and D&C-contracts specifically. The question therefore remains what exactly explains the occurrence of additional work in DBFM-projects. Future analyses may delve into this question.

Our study is subject to some limitations. First, our dataset included only nine DBFM-projects and it is thus important to continue the collection of actual performance data on DBFM-projects to further strengthen the evidence-base. Second, although the project completeness is high, and although projects with full completeness were not significantly different from the projects that were still incomplete, future analyses may be performed on the data when all the projects have concluded their implementation phases to further strengthen the results.

As a final reflection, in this paper we have looked into the cost and time performance of projects. Put differently, do PPPs achieve better results when it comes to cost and time overrun than traditionally procured projects (Flyvbjerg et al., 2003)? The answer is 'yes' for cost overrun and 'it looks like it, but not sure' for time overrun. Arguably, this focus on costs and time, however, is rather narrow. Current policy debates stress the value of PPPs in achieving, e.g., innovative and sustainable transport solutions by capitalizing on the innovative capacities of the private sector. It raises the question whether some time delays and additional project costs are acceptable if it results simultaneously in increased project quality, sustainability, or other perhaps unforeseen social benefits. It reminds us that we should not blindly focus on cost and time performance, and that PPPs may prove to be valuable vehicles for other reasons too.

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