Boundary spanning for contractual fairness in public infrastructure projects: its impact on performance and innovation

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Boundary spanning for contractual fairness in public infrastructure projects: its impact on performance and innovation

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ABSTRACT
While the literature on public-private collaboration in large infrastructure projects stresses both contractual and relational governance mechanisms for good outcomes, less attention has been paid to the role of boundary spanners and the way the contract is enforced in practice. This study contributes by bringing in the concept of contractual fairness building on organizational justice theory. It tests the effect of boundary spanning activities on contractual fairness and their impact on performance and innovation as two different outcomes. Findings indicate that boundary spanning activities positively affect contractual fairness, innovation, and performance, while contractual fairness partly mediates the relationship with performance.

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KEYWORDS Infrastructure projects; public–private partnerships; boundary spanning; contractual fairness; performance; innovation

Introduction
Large public infrastructure projects have been appealing to the imagination for a long time. Not only because of their impact in public space but also due to their physical and financial size. Earlier research has shown that large public infrastructure projects face substantial complexity and struggle to perform as expected. Many of these projects therefore face large cost and time overruns (Cantarelli 2011). Public administration research has therefore paid attention to infrastructure projects, focusing among others on the collaboration between public clients and private contractors (e.g. Warsen et al. 2019); the management of these projects (e.g. Brunet 2019), and their performance (e.g. Cantarelli and Flyvbjerg 2013; Moschouli et al. 2018; Verweij and Van Meerkerk 2021).

Contracts play a major role during the implementation phase of infrastructure projects in relation to their performance (e.g. Verweij and Van Meerkerk 2021). However, few studies have examined the enforcement thereof and how this affects...
performance (Roehrich et al. 2020). An exception is the work of Karaba et al. (2022) who recently studied the role of boundary objects in contracts and how this influences information exchange during implementation. The first gap in the literature this study aims to start filling is about how contracts are enacted during the implementation phase and the impact thereof on performance and innovation of infrastructure projects. We thereby build upon organizational justice theory and elaborate the concept of contractual fairness, which is, as we argue, suited to capture this element of handling the contract. We specifically focus on how sanctions are applied and how unforeseen circumstances are dealt with – as this is understudied (Dewulf and Garvin 2020; Warsen 2021). We contribute to further theory development and empirical research by including contractual fairness as an explanatory factor in relation to project performance and innovation of public infrastructure projects.

Albeit infrastructure projects are governed by elaborate contracts, these contracts are not able to address the inherent uncertainty of complex projects, such as unforeseen circumstances and stakeholder dynamics (e.g. Brown, Potoski, and van Slyke 2016). Therefore, next to contractual governance mechanisms, an increasing body of literature emphasizes the importance of relational governance mechanisms for the performance of public infrastructure projects (Warsen et al. 2018; Roehrich et al. 2014; Zheng, Roehrich, and Lewis 2008). This literature points out the importance of relational dimensions, like trust and (informal) contacts between partners (Brown, Potoski, and van Slyke 2016; Poppo and Zenger 2002; Roehrich et al. 2014; Zheng, Roehrich, and Lewis 2008). Boundary spanners play an important role in relational governance, as they build inter-personal relationships, manage information exchange, align interest and coordinate across boundaries (Noble and Jones 2006; Satheesh et al. 2022; Van Meerkerk and Edelenbos 2014; Williams 2012). Boundary spanners can be defined as ‘people who proactively scan the organizational environment, employ activities to cross organizational or institutional boundaries, generate and mediate the information flow and coordinate between their “home” organization or organizational unit and its environment, and connect processes and actors across these boundaries’ (Van Meerkerk and Edelenbos 2018, 58).

The second gap this study aims to start filling is examining the impact of boundary spanners on contractual fairness, performance and innovation, thereby linking relational and contractual governance mechanisms. While some previous studies have examined the role of boundary spanning activities and relations in infrastructure collaboration (Noble and Jones 2006; Roehrich et al. 2014; Satheesh et al. 2022), their potential role and impact for contract management have not been examined before. This is an important gap to start filling, as it adds to our understanding of how both contractual governance and relational governance mechanisms interact and impact on performance and innovation (see also Warsen, Klijn, and Koppenjan 2019). During the implementation phase of these projects, unexpected circumstances are likely to occur, raising chances of conflicting interests and information deficits coming to the surface, with accompanying risks for poor project performance (Karaba et al. 2022). The role of boundary spanners in managing information exchange and relational dynamics can be important to deal with these circumstances, and in consequence affecting the projects’ performance and innovation.
Hence, in this article, we examine the effect of boundary spanning activities, contractual fairness and their impact on innovation and performance of infrastructure projects. This leads to the following research question: What are the effects of boundary spanning activities and contractual fairness on the performance and innovation in public infrastructure projects? In line with previous studies, we consider performance to be a multidimensional concept (Cantarelli and Flyvbjerg 2013; Petersen 2019), including different criteria, like time, cost-quality performance, and the perceived relevance of the proposed solution. Innovation is measured by the perceptions of respondents regarding the use of new technologies and the development of new solutions. We use structural equation modelling on data derived from a survey among public and private managers working on Dutch public infrastructure projects ($N = 161$) to test the mediation model between boundary spanning activities, contractual fairness, innovation, and performance.

**Theoretical framework and hypotheses**

In this section, we first elaborate on the performance of and innovation in public infrastructure projects. Next, we discuss the role of contracts and introduce the concept of contractual fairness to better examine how contracts are enacted and how this could affect the performance and innovation of infrastructure projects. Subsequently, we discuss boundary spanning as an important relational governance mechanism in relation to achieving contractual fairness as well as impacting on performance and innovation in infrastructural projects.

**Performance and innovation in public infrastructure projects**

The performance of public infrastructure projects is a much-debated topic (e.g. Flyvbjerg, Skamris Holm, and Buhl 2003; Moschouli et al. 2018). Large infrastructure projects struggle to meet deadlines and budgets, resulting often in cost and time overruns (see, for example, Cantarelli and Flyvbjerg 2013; Verweij and Van Meerkerk 2021). However, performance is not merely based on cost and time. As a multi-dimensional construct, other indicators, such as quality, are frequently included (Hodge and Greve 2017; Petersen 2019; Warsen 2021). Moreover, the question for whom the project should be a success is an intriguing question. Partners and stakeholders have diverging interests and use different criteria to judge outcomes. Success for one partner might mean a disappointment for the other (Hodge and Greve 2017). The public client would like to have high-quality for a low price, whereas the private contractor needs to make a reasonable profit. This means that objective outcomes, such as cost and time, may not always be the only relevant indicators of performance, and that we might need to include multiple criteria when looking at performance. The inclusion of broader indicators such as perceived robustness of the results and support of stakeholders are often suggested (see for instance Klijn and Koppenjan 2016) and increasingly emphasized in infrastructure governance literature (Hodge and Greve 2017; Koppenjan et al. 2022; Petersen 2019; Warsen 2021). These dimensions are interrelated and influence each other. For instance, a good cost–quality relation will very likely be related to goal achievement if staying within the budget is one of the goals. Hence, different indicators accentuate different dimensions of performance, but are also related.
Innovation is another increasingly discussed outcome of public infrastructure projects (Callens, Verhoeest, and Boon 2021; Himmel and Siemiatycki 2017). A widely shared definition of innovation is presented by Rogers (2003, 12) who defines innovation as an ‘idea, practice, or object that is perceived as new by an individual or other unit of adoption’. As Callens et al. (2021) emphasize, the degree of innovativeness is in the eye of the beholder. The perceived newness of an implemented solution as evaluated by the various actors determines whether or not they consider it innovative. Innovations may focus on both the product and the process (Lember et al. 2019). Product innovations result in a new product, such as the use of a new type of tarmac in the construction of a highway. In contrast, process innovations – such as modular construction systems – focus on how the project is realized (Callens, Verhoeest, and Boon 2021). Institutional innovations, like changes in an organization, are also considered innovation (Lember et al. 2019) but are left out of the scope of this paper due to our focus on project-level innovation.

The actual development of innovative project outcomes is closely related to the allocation of risks. Infrastructure projects with an integrated contract, such as public–private partnerships, hold the promise of innovation (Himmel and Siemiatycki 2017; Hueskes, Koppenjan, and Verweij 2019). By integrating various project phases and allocating the accompanying risks to the private partner, there are strong incentives for private partners to implement innovations in earlier phases that result in benefits in the subsequent maintenance phase (Roumboutsos and Saussier 2014). However, allocating risks to private partners might make them less inclined to implement major innovations due to the accompanying risks. After all, these innovations are not yet proven technology and therefore create uncertainty and thus imply risk (Himmel and Siemiatycki 2017). In consequence, small, incremental innovations are more likely in public infrastructure projects (Roumboutsos and Saussier 2014).

**Contractual management: types and limitations of contracts**

According to transaction cost economics, contracts are a key governance mechanism. They can be defined as ‘detailed, binding legal agreements that specify the obligations and roles of both parties in a relationship’ (Roehrich et al. 2014, 223–224). Contracts may prevent opportunistic behaviour, as exchanges between public principals (clients) and private agents (contractors) in public infrastructure projects are characterized by incomplete information and information asymmetry (Bertelli and Smith 2009; Hodge, Greve, and Boardman 2010; Williamson 1979). This is often referred to as the safeguarding function of contracts. In addition, by delineating clear roles and responsibilities contracts have a coordination function (Schepker et al. 2014; Selviaridis 2016). This applies in particular when complex tasks are completed across organizational boundaries, and actions and the division of labour need to be coordinated (Schepker et al. 2014). Next to these functions, the adaptation function is another function of contracts. To deal with uncertainty, change, and unexpected events, contracts often include provisions for change procedures or force majeure (Schepker et al. 2014). Finally, contracts may display a codification function, which implies that they help to facilitate the development of mutual understanding about goals, expectations and requirements during the exchange (Selviaridis 2016). Given the various contract functions, both performance and innovation of public infrastructure projects are likely to be influenced by the use of contracts in these projects (Roehrich et al. 2020).
Contracts specify the features of the product (product rules), the roles and responsibilities, what happens if partners fail to deliver, how payment is organized, and how to act in unforeseen circumstances (process rules).

Contracts come in all shapes and sizes. One possible way to categorize the diversity of infrastructure contracts is to focus on which elements of the infrastructure project lifecycle are integrated in one contract (e.g. Lenferink, Tillema, and Arts 2013). Design and construct (D&C) contracts, for example, leave both the design and the construction of the project to a private contractor, whereas more integrated contracts assign the responsibility for the design, build, financing, and maintenance (e.g. DBFM contracts) to a private consortium, resulting in a long-term collaboration (e.g. Lenferink, Tillema, and Arts 2013).

However, using contracts as the main governance mechanism has its limitations. Contracts are always incomplete (Brown, Potoski, and van Slyke 2016; Bertelli and Smith 2009). It is not possible to cover all potential circumstances and foresee future developments (Davis 2007). Given the complexity and long duration of these projects, unexpected events and developments will certainly occur, for which the contract has no solution. How the contract is used in case of unexpected events and circumstances is, however, not much examined in the literature on inter-organizational governance, as is shown by a recent review of Roehrich et al. (2020), while this is likely to be important for the relational dynamics and performance of infrastructure projects (Karaba et al. 2022; Poppo and Zenger 2002; Warsen, Klijn, and Koppenjan 2019). In this respect, organizational justice theory can complement transaction cost-based perspectives on contractual governance (Husted and Folger 2004).

**Contractual fairness and its expected impact on performance and innovation**

Building on organizational justice theory, we use the concept of contractual fairness to examine how decisions are made (and how this is perceived) when contractual agreements cannot be met or decisions on sanctions are taken. In organization justice theory, fairness refers to ‘the perception by a person that a decision, outcome, or procedure is both balanced and correct’ (Husted and Folger 2004, 720). This can include both distributional fairness and procedural fairness (Folger and Konovsky 1989; Poppo and Zhou 2014). Distributive fairness refers to the evaluation of an outcome related to an allocation decision, whereas procedural fairness refers to the process of how an allocation decision is made (e.g. in a transparent manner) (ibid). The latter is particularly relevant for public infrastructure projects in the face of sanctions or unforeseen events that jeopardize contractual agreements. As Poppo and Zhou (2014, 1511), in the context of interfirm exchanges, note: ‘Because exchange parties are likely to have different and conflicting interests and perspectives, resolution is difficult when parties disagree about goals and preferred outcomes. In such conditions, fairness becomes paramount as parties manage conflict resolution’.

The basic assumption following from organizational justice theory is that partners accept matters as agreed upon in the contract more easily when the contract and contract management is considered fair and in line with the context of the project (Rousseau and Aquino 1993). This applies, for example, to conflict resolution and when decisions on applying sanctions are made. Such decisions should be perceived as fair and just to be accepted and/or not undermining the relational quality between partners in the project. Both literature on relational governance (e.g. Poppo and
Zenger 2002; Warsen, Klijn, and Koppenjan 2019) and organizational justice (Gopinath and Becker 2000; Poppo and Zhou 2014; Zhang, Jia, and Schalk 2010) stress that project partners should take circumstances into account when applying sanctions. After all, sanctions are designed to prevent unwanted behaviour rather than to punish project partners who did everything in their power to meet the requirements but failed due to events they could not control.

Research on contractual fairness in interfirm exchanges (in case, buyer–supplier relationships) shows that contractual fairness positively influences exchange performance (Poppo and Zhou 2014). Related studies on procedural fairness found positive relationships with organizational commitment in joint ventures (Johnson, Korsgaard, and Sapienza 2002) and operational outcomes of strategic alliances (Luo 2008). In a similar line, we argue that contractual fairness will positively affect innovation and performance of public infrastructure projects. After all, contractual fairness will have a benevolent effect on how partners deal with unexpected events which is one of the major challenges in infrastructural projects. Moreover, contractual fairness might have a positive effect on the commitment of the partners. It could make partners less risk averse which will both have a positive effect on performance and innovation (Poppo and Zhou 2014). This leads to the following hypotheses:

**H1** Contractual fairness, as perceived by public and private project managers, will be positively associated with better performance of public infrastructure projects.

**H2** Contractual fairness, as perceived by public and private project managers, will be positively associated with more innovative outcomes of public infrastructure projects.

Next to contractual governance mechanisms, previous studies have shown that these mechanisms are often complemented with relational governance mechanisms, which focus more on informal exchange, information sharing, and trust (Cao and Lumineau 2015; Poppo and Zenger 2002; Warsen, Klijn, and Koppenjan 2019). To foster contractual fairness in infrastructure projects, we argue that boundary spanners play an important role given their influence on creating mutual understanding, good information exchange and relationship-building activities.

**The role of boundary spanning activities**

Boundary spanners manage the interface between their ‘home organization’ and the organizational environment (Van Meerkerk and Edelenbos 2014). They play an important role in managing the relationship in the collaboration between public and private actors in public infrastructure projects. Different (interrelated) boundary spanning activities are important for interorganizational collaboration (Satheesh et al. 2022; Williams 2012). In this study, we focus on information exchange, relationship building and maintenance, and coordination activities. Regarding the first, boundary spanners actively mediate the information flow across boundaries (Birkinshaw, Ambos, and Bouquet 2017; Tushman and Scanlan 1981). This not only involves information collection from the external project environment and dissemination but also filtering, sorting, and translating information to the home organization and vice versa (ibid). Second, successful collaboration requires the ability to connect stakeholders across boundaries (Klijn, Edelenbos, and Steijn 2010). To do
this, inter-organizational relationships must be created and maintained, which are for an important part based on informal and personal relationships (Roehrich et al. 2014; Van Meerkerk and Edelenbos 2018). Boundary spanners must establish strong connections both inside their own organization and with the partnering organization to align the interests of the cooperating parties (Tushman and Scanlan 1981; Van Meerkerk and Edelenbos 2018). Lastly, coordination and alignment between the boundary spanners’ home organization and the partners in the collaboration is an important boundary spanning activity, allowing for a tighter coupling and smooth running of cross-boundary collaboration (Williams 2012).

A stronger presence of these boundary spanning activities by project managers is likely to impact on the way the contract between public and private counterpart is managed in practice. Competent boundary spanners have a feeling for the interests of the partner organization, see other actors’ needs and have developed an understanding of their situation (Van Meerkerk and Edelenbos 2014; Williams 2012). This enables them to search for common ground (Levina and Vaast 2005). In doing so, they might find workable solutions for unexpected events and circumstances – and thus enhance the perception of contractual fairness according to partners. This leads to our third hypothesis:

**H3** A stronger presence of boundary spanning activities will be positively associated with a higher level of contractual fairness in public infrastructural projects.

Research on innovation stresses the importance of knowledge transfer and (informal) boundary spanning activities in this respect (Cross et al. 2015). Theory on knowledge transfer and social learning assumes that for tacit knowledge exchange, personal and informal relationships are important as this enables rich interactions in which learning can occur, thinking about problems and solutions in a new light (Cross et al. 2015). With their role in knowledge exchange and relationship-building activities, boundary spanning activities are able to foster innovation. Several studies in the field of business management and administration find a positive relationship between boundary spanning activities and innovativeness (e.g. Bullinger et al. 2010; Gao, Xu, and Yang 2008). This relationship is generally explained by the nature and level to which knowledge from the organizational environment is collected and diffused, shared and exchanged with other members of the organization. By their contribution in (tacit) knowledge exchange and the collection of new information, boundary spanning activities play an important role in developing new insights and learning, which in turn foster innovative capacity (Gao, Xu, and Yang 2008; Van Meerkerk and Edelenbos 2018). Likewise, we expect that the presence of boundary spanning activities in managing complex public infrastructure projects will lead to more innovation. This leads to the following hypothesis:

**H4** A stronger presence of boundary spanning activities will be positively associated with more innovative outcomes of public infrastructure projects.

Dealing effectively with complex public infrastructure projects requires a high flow of information between involved actors. Especially since goals are not always
straightforward and often diverse (Klijn and Koppenjan 2016). Furthermore, the realization of public infrastructure requires mutual alignment and coordination of project partners and other stakeholders influenced by these projects. In addition, the length and complexity of public infrastructure projects create high demands for good coordination among project partners to realize good performance. With their role in increasing the flow of information, translating information, building relationships and coordinating across boundaries, boundary spanning activities could contribute to the performance of such complex projects, as found in previous research on complex urban development projects (Van Meerkerk and Edelenbos 2014). This leads to the following hypothesis:

**H5** A stronger presence of boundary spanning activities will be positively associated with better performance of public infrastructure projects.

Assuming that boundary spanning activities affect the perception of contractual fairness with the partners and that contractual fairness influences innovation and performance, we expect a partially mediating role of contractual fairness:

**H6a** Contractual fairness partly mediates the relationship between boundary spanning activity and innovation of public infrastructure projects.

**H6b** Contractual fairness partly mediates the relationship between boundary spanning activity and performance of public infrastructure projects.

The various hypotheses are displayed in Figure 1.

![Conceptual model](Figure 1)
Methods

The data for this paper was collected using a survey among leading project managers working in Dutch public infrastructure projects. Keeping the context as similar as possible, we concentrated on major transport infrastructure projects (road and waterway infrastructure). Minor maintenance projects, knowledge projects, etc., were excluded because of different stakeholder, procurement and management dynamics (Verweij and Van Meerkerk 2021). In the Netherlands, large transport infrastructure projects are mostly implemented based on a Design and Construct (D&C) or Design Build (Finance) Maintain (DB(F)M) contract. An important difference between D&C and DBFM lies in contract duration. DBFM includes the maintenance phase, in which the private contractor is responsible for maintenance of the asset after construction for up to 30 years (Koppenjan et al. 2022.). To keep the unit of analysis (see below) similar, we focus on the implementation phase. The implementation phase of these projects is similar in terms of deliverables, milestones and complexity. Given differences in especially the financing and maintenance of these projects, we controlled for the type of contract in our model testing. A project was selected only if it had one of the aforementioned contract types and if it was a major infrastructure development project.

In the Netherlands, public infrastructure projects are tendered using DBFM contracts, unless the project (a) is too small, (b) too complex or (c) involved several uncertainties for the future. Public procurement of infrastructure projects using DBFM contracts is rather costly and time-consuming. Furthermore, the long-term nature of these contracts leaves little room for uncertainties in the future, as the contract is drafted beforehand (Lenferink, Tillema, and Arts 2013).

Unit of observation and unit of analysis

Our unit of observation concerns public and private project managers who are (or have been) involved in DBFM and D&C infrastructure projects in the Netherlands. Given their involvement, they can identify boundary spanning activities within the project and make a good and informed assessment of the performance of these projects. In collaboration with Rijkswaterstaat and Bouwend Nederland, a list of public and private project managers was compiled.

As we are examining performance and innovation on the project level, as well as boundary spanning activities and contractual fairness as enacted and experienced during the project, our unit of analysis concerns the project level, more specifically, the implementation phase. Each respondent was asked to complete the survey for a specific project in which she/he/they were involved. All respondents were involved in projects that were in the implementation phase. This enhances comparability of the assessments. Moreover, only in this phase it becomes clear which innovative ideas – developed during the design phase – are realized and if the project is delivered on time, within budget and to satisfaction.

In total, 396 public and private project managers received a request to fill out the survey. The survey data were collected from October 2019 to February 2020. We received 163 completed questionnaires, resulting in a response rate of 41%. This is a reasonable sample size for doing SEM analysis, given the number of factors in the model, the number of indicators used and the relatively high factor loadings (see
below) (see Westland 2010; Wolf et al. 2013). The response rates of public sector ($N = 71, 44\%$) and private sector respondents ($N = 92, 39\%$) were quite similar. The distribution of the responses over contract type is as follows: 112 responses for DB(F) M-based projects and 51 responses for D&C-based projects.

**Measurement of the core variables**

To measure the performance of infrastructure projects, we follow previous research showing that performance is a multi-dimensional concept and therefore is best measured by including multiple criteria. These criteria include asset quality, on-time and on-budget delivery and cost-effectiveness (Flyvbjerg, Skamris Holm, and Buhl 2003; Hodge, Greve, and Boardman 2010; Petersen et al. 2019). We used six items to measure performance, including items about quality, robustness and support of project results, one item on on-time delivery, and two items on cost performance. The performance items are a reflective scale (see Bollen and Lennox 1991): each item accentuates specific aspect of performance, but the items are also interrelated and partly overlapping.

To measure innovation, we used five items from a previously used scale, focusing on project-level innovation in the realization phase (see Klijn and Koppenjan 2016). Building on the literature on organizational fairness and procedural justice (Gopinath and Becker 2000; Luo 2008; Poppo and Zhou 2014), we developed a scale for measuring contractual fairness, using five items that focus on the use of sanctions, the degree to which project partners are sensitive to the circumstances, and the way they use the contract when solving disagreements. We validated the items with several practitioners in the development of the survey. Both exploratory and confirmatory factor analyses demonstrated convergent and discriminant validity (see also the factor loadings, the AVE and SIC in Table 1). Cronbach’s Alpha for this new scale is good (.90). Finally, boundary spanning activity is measured using the previous developed and tested scale of Van Meerkerk and Edelenbos (2014). We slightly adapted the items to the context of this research. We used four items instead of five, as these four items best fit within the context of public–private collaboration in managing complex infrastructure projects. All items are presented in Table 1.

**Reliability and validity**

The measurement model has been examined for convergent and discriminant validity based on the confirmatory factor analyses (see Table 1). The factor loadings of all construct items are $\geq .52$ and most go beyond $.70$ which is a first indicator to demonstrate convergent validity (Hair et al. 2010). A second indicator is the AVE, which for all constructs is higher than the threshold of $.50$. To establish discriminant validity, we compared the average variance extracted (AVE) with the squared inter-construct correlation estimates (SIC). The AVE of all constructs is larger than the corresponding squared inter-construct correlations, which means that the indicators have more in common with the construct they are associated with than they do with other constructs. In addition, the composite reliability values of the constructs are high and exceed the $.70$ threshold. To further assess the reliability of the measures, we computed corrected item-to-total correlations and Cronbach’s alphas. All items had corrected item-to-total correlations that were greater than $.40$, which represents a general threshold (Field 2005). All Cronbach’s alphas exceeded the widely accepted cut-off value of $.70$. 


Table 1. Survey items for performance, innovation and contract management.

<table>
<thead>
<tr>
<th>Constructs and items</th>
<th>Standardized factor loadings</th>
<th>Cronbach’s Alpha/Composite reliability, AVE, SIC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Performance (P) (7-point scale)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The results of the project have enough support of the involved organizations</td>
<td>.78</td>
<td></td>
</tr>
<tr>
<td>The solutions that have been developed really tackle the problems at hand</td>
<td>.72</td>
<td>AVE: .51</td>
</tr>
<tr>
<td>The goals formulated at the start of the project have been met</td>
<td>.80</td>
<td>SIC:</td>
</tr>
<tr>
<td>The costs of the project stay within the set bandwidth and norms</td>
<td>.71</td>
<td>P – IO: .00</td>
</tr>
<tr>
<td>The revenues of this project are in general larger than the costs</td>
<td>.64</td>
<td>P – CF: .41</td>
</tr>
<tr>
<td>The availability of the developed infrastructure is realized within the agreed time period</td>
<td>.60</td>
<td>P – BSA: .27</td>
</tr>
<tr>
<td><strong>Innovative outcomes (IO) (10-point scale)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compared to similar projects, there were no/many innovative solutions developed in this project</td>
<td>.77</td>
<td>.88/.88</td>
</tr>
<tr>
<td>In this project, no/many new technologies have been developed in the realization phase</td>
<td>.88</td>
<td>AVE: .60</td>
</tr>
<tr>
<td>In this project, there is a little/lots of time and money invested in research to, and development of, new techniques or construction processes</td>
<td>.79</td>
<td>SIC:</td>
</tr>
<tr>
<td>In this project, no/a lot of new technology has been used in the realization phase</td>
<td>.85</td>
<td>IO – CF: .01</td>
</tr>
<tr>
<td>The innovative character of the project is far below/above the expectations I had prior to the start of the project</td>
<td>.52</td>
<td>IO – BSA: .03</td>
</tr>
<tr>
<td><strong>Contractual fairness (CF) (10-point scale)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>When contractual agreements cannot be met, management is insensitive/sensitive to the circumstances</td>
<td>.58</td>
<td>.90/.90</td>
</tr>
<tr>
<td>In case of a disagreement, the parties only look for solutions that fit within the contract/seek satisfactory solutions, whether this is based on the contract or not</td>
<td>.69</td>
<td>AVE: .66</td>
</tr>
<tr>
<td>Decisions on sanctions are not made in a fair way/are made in a fair way</td>
<td>.91</td>
<td>SIC:</td>
</tr>
<tr>
<td>Decisions on sanctions are not made in a transparent manner/are made in a transparent manner</td>
<td>.88</td>
<td>CF – BSA: .30</td>
</tr>
<tr>
<td>Decisions on sanctions are made with little regard for the circumstances/are made taking the circumstances into account</td>
<td>.93</td>
<td></td>
</tr>
<tr>
<td><strong>Boundary spanning activity (BSA) (7-point scale)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Among our project partners there are people active who:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>... have a feeling of what is important for the various project partners</td>
<td>.86</td>
<td></td>
</tr>
<tr>
<td>... take care of a good information exchange between the various project partners</td>
<td>.93</td>
<td>AVE: .82</td>
</tr>
<tr>
<td>... are able to build and maintain relationships between the various project partners</td>
<td>.90</td>
<td></td>
</tr>
<tr>
<td>... take care of good coordination between the various project partners</td>
<td>.92</td>
<td></td>
</tr>
</tbody>
</table>

**Control variables**

We selected four control variables to test whether the measured effects on our dependent variables are not caused by specific characteristics of the project or the respondents. Regarding the projects, we included project size and contract type as control variables. Project size might increase the difficulty of realizing good performance due to increasing complexity and demand for coordination (see Klijn, Edelenbos, and Steijn 2010). The specific type of contract (DBFM or D&C) is found to influence some aspects of performance, such as cost and time performance (Verweij and Van Meerkerk 2021). With regard to the reporting
managers, we included the number of years the respondent has been involved in the project as the manager. This is a general check on whether the respondent has participated for a sufficiently substantive amount of time to be able to make an experience-based judgement. Furthermore, we included the experience (measured in years) of the project manager with complex infrastructure projects. Finally, we included their organizational background (public or private sector), as this might influence their perceptions of, e.g., the performance of these projects.

**Common source bias**

The dependent, independent, and mediating variables in this study are measured using the same survey. Therefore, this section addresses several measures we took to deal with the potential issues that might arise from a common source bias. First, for this survey we have approached almost the entire population, which minimizes the risk of sampling errors in this study. Second, we used different scales (e.g. both 10-point and 7-point Likert scales) and presented the different variables on different pages of the (online) survey. These are important procedural remedies to deal with common source bias (Podsakoff et al. 2003). Third, we conducted a post hoc statistical analysis: we used a Harman one-factor test (Podsakoff et al. 2003). A factor analysis was conducted on all items used to measure the core variables covered by the hypotheses. No single factor accounted for the majority of the explained variance. To conclude, although we acknowledge potential limitations of common source bias, we took several design and statistical remedies to deal with this. We see no indication that relationships between the variables are inflated because of it.

**Data analysis: structural equation modelling**

We used structural equation modelling (SEM) to test the conceptual model (for which we used AMOS Version 22.0). This has several advantages compared to regression analysis (Byrne 2010). First, SEM allows simultaneous analysis of all the variables in the model instead of separately and it enables measurement of direct and indirect effects. Second, SEM has the capability to deal with latent variables, by using separate factor loadings for the observed indicators (the survey items), thereby incorporating both unobserved constructs and observed indicators in the model. Third, whereas traditional multivariate procedures are incapable of either assessing or correcting for measurement error, SEM provides explicit estimates of these error variance parameters, thereby improving the accuracy of the data analysis (Byrne 2010). One modification to enhance the model concerned the correlations of errors, which can be used if ‘in case of multiple questionnaire items, correlated errors may arise from items that are very similarly worded . . .’ (Brown 2015, 157). We performed within factor error correlations: contractual fairness (items 1 and 2), innovative outcomes (items 1 and 5), and performance (items 2 and 6; items 3 and 4; items 3 and 6; and items 5 and 6).
Results

In this section, we present the results from our analysis. First, Table 2 shows the means, standard deviations, and correlations for all model constructs and control variables. The mean scores on boundary spanning activity, contract management, and performance are above the mid-range, indicating that respondents generally perceive quite some boundary spanning activities. Generally, managers experience fairness when it comes to the implementation of the contract in their project and assess the project performance as quite good. The mean score on innovation outcomes is just below the mid-range of the scale, indicating that managers in general are quite critical on innovation in the project. This is not surprising given the often-limited flexibility and the allocation of risks in infrastructure projects, especially those with an integrated contract, such as DBFM-projects (Koppenjan et al. 2022; Roumboutsos and Saussier 2014; Verweij and Van Meerkerk 2021). Even though the potential for innovation in DBFM-projects is considered substantive (e.g. Hueskes, Koppenjan, and Verweij 2019; Roumboutsos and Saussier 2014), previous studies have shown that major innovations are not to be expected as the required detailed specifications in the contract may hinder innovations (e.g. Himmel and Siemiatycki 2017).

Yet, according to respondents, there is, on average, more innovation in DBFM projects reported compared to infrastructure projects based on a D&C contract. These findings are in line with an earlier study by Himmel and Siemiatycki (2017) who have shown that excluding either the design and/or maintenance phase from the contract narrows the scope and incentive to innovate. Public managers on average score performance higher compared to their private counterparts. Public managers also report slightly more boundary spanning activities and contractual fairness. Project size correlates with both innovation and performance. Larger infrastructure projects have more room for innovation, hence the positive correlation. However, due to their size and complexity, large infrastructure projects face more difficulties in achieving good performance. This is reflected by the negative correlation between project size and performance.

Figure 2 shows the standardized regression coefficients of the structural model tests. Control variables were also regressed on all variables in the model. Those control variables which showed significant relationships with one (or more) core variables are included in the final model. The presented model had the best fit. The overall fit of the measurement model was tested by the following fit indices, which resulted in CMIN/DF = 1.38; CFI = .96; RMSEA = .05 and PCLOSE = .57. These values indicate a good fit of the measurement model with the data (Byrne 2010).

First, hypothesis 1 is confirmed in this model, suggesting a positive effect of contractual fairness on performance. The analysis shows a moderate to strong relationship with a standardized regression coefficient of .44 (p < .001). Hypothesis 2 cannot be confirmed, as the relationship between contractual fairness and innovative outcomes is not found to be significant. In contrast, hypotheses 3, 4 and 5 are confirmed. The presence of boundary spanning activities positively relates to contractual fairness (H3) with a standardized regression coefficient of .51 (p < .001), showing a moderate to strong effect. Furthermore, there is a significant and positive relation between boundary spanning activities and innovative outcomes (H4), although this effect is not very strong (β = .21; p < .01). Boundary spanning activities are also positively related to performance (β = .23; p < .01), confirming hypothesis 5. Again, this relationship is not
Table 2. Means, standard deviations and correlations for all model constructs and control variables (N = 163).

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>SD</th>
<th>BSA</th>
<th>CF</th>
<th>IO</th>
<th>P</th>
<th>Contr.</th>
<th>Proj. Size</th>
<th>Org. backgr.</th>
<th>Years of involv.</th>
<th>Years of exper.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boundary spanning activity (1–7)</td>
<td>5.11</td>
<td>1.32</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contractual fairness (1–10)</td>
<td>7.51</td>
<td>1.82</td>
<td>.551*</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Innovative outcomes (1–10)</td>
<td>5.38</td>
<td>2.00</td>
<td>.215**</td>
<td>.122</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Performance (1–7)</td>
<td>5.13</td>
<td>1.35</td>
<td>.441**</td>
<td>.559**</td>
<td>−.030</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contract (DBFM = reference)</td>
<td>N/A</td>
<td>N/A</td>
<td>.963</td>
<td>.039</td>
<td>.399**</td>
<td>−.156</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project size (1–4)</td>
<td>2.93</td>
<td>1.27</td>
<td>−.039</td>
<td>−.052</td>
<td>.425**</td>
<td>−.199*</td>
<td>.557*</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Org. background (Public = reference)</td>
<td>N/A</td>
<td>N/A</td>
<td>.166*</td>
<td>.334*</td>
<td>−.024</td>
<td>.395**</td>
<td>−.092</td>
<td>−.059</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Years of involvement</td>
<td>4.07</td>
<td>2.38</td>
<td>.141</td>
<td>.233**</td>
<td>.033</td>
<td>.387**</td>
<td>−.081</td>
<td>.099</td>
<td>.301**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Years of experience</td>
<td>14.84</td>
<td>6.60</td>
<td>.001</td>
<td>−.002</td>
<td>.147</td>
<td>−.122</td>
<td>−.001</td>
<td>.102</td>
<td>−.137</td>
<td>.224**</td>
<td></td>
</tr>
</tbody>
</table>

** p < 0.01; * p < 0.05.
strong, in particular compared to previous research (see Van Meerkerk and Edelenbos 2014, 2018). This is probably due to the effect of contractual fairness, partly mediating the effect of boundary spanning activity on performance. This is tested in hypothesis 6b. The standardized indirect effect of boundary spanning activity on performance is .22 (.51 × .44), which results in a standardized total effect of .45 (.22 + .23). To estimate the significance of this mediation effect, we performed the bias-corrected bootstrap method described by Shrout and Bolger (2002). We requested 2000 bootstrap samples. The indirect effect of boundary spanning activity on performance is found to be significant (p < .001), confirming hypothesis 6b. As contractual fairness is not found to be related to innovative outcomes, hypothesis 6a, testing a possible mediation effect of contractual fairness in the relationship between boundary spanning activity and innovative outcomes, is also not confirmed.

We omitted the control variables that had no significant effects on the dependent variables. This concerned the contract type (DBFM or D&C). This might be due to the inclusion of the control variable ‘project size’. Dutch policy emphasizes that DBFM should only be used for public infrastructure projects with a contract value of at least 60 million euros (Verweij and Van Meerkerk 2021). Therefore, the average size of DBFM-projects is larger than that of D&C projects. In fact, project size showed a significant relationship with both innovation and performance. Its relationship with innovation is positive and quite strong (β = .45; p < .001), whereas the relationship with performance is negative (β = −.23; p < .001). The SEM analysis shows the relation between contract type and innovative outcomes is no longer significant once we correlate contract type with project size. Also, the model fit weakens significantly when contract type and project size are not correlated. These are indicators that the strong correlation between project size and contract type affects the role of contract type in this analysis. Another significant control variable concerns the organizational
background of the respondents. Public managers scored contractual fairness significantly higher than their private sector counterparts ($\beta = .29; p < .001$). Finally, the years of involvement of the respondent in a project is positively related to performance: ($\beta = .37; p < .001$), while overall years of experience is negatively related ($\beta = -.16; p < .05$).

**Discussion and conclusions**

Our findings contribute to the research gaps formulated at the start of this article regarding the importance of boundary spanning and contractual fairness. The results indicate that boundary spanning activities have a positive effect on performance and innovation and stimulate contractual fairness. Second, our findings suggest a partly mediating role of contractual fairness in the relationship between boundary spanning activities and performance. With the introduction of contractual fairness, we aimed to add to the debate on contractual and relational governance of infrastructure projects (Roehrich et al. 2014; Warsen, Klijn, and Koppenjan 2019; Zheng, Roehrich, and Lewis 2008) both theoretically and empirically by connecting it to literature on fairness in contracting research. The empirical findings of this study confirm the impact of contractual fairness on infrastructure project performance and emphasize that, to better understand the performance of public infrastructure projects, we need to look beyond merely safeguarding and coordinating functions of contracts (Poppo and Zhou 2014; Roehrich et al. 2020; Schepker et al. 2014).

Moreover, we showed the important role of boundary spanning activities in enhancing contractual fairness perceptions. This emphasizes the role of relational governance mechanisms in explaining performance, as boundary spanning clearly represents a relational feature (Klijn and Koppenjan 2016; Zheng, Roehrich, and Lewis 2008). With their role in relationship building, knowledge exchange and with having a good, developed feeling for the interest of the partner, boundary spanners influence decision-making on contract management and fairness perceptions, as this study shows. These activities enhance actors’ understanding for the goals of their counterparts and align the interests of the project partners (Van Meerkerk and Edelenbos 2018). While previous literature showed the importance of informal and boundary spanning relationships in the early stages of collaboration (Roehrich et al. 2014), prior to signing the contract, this study shows that these boundary spanning activities and relationships play an important role during the implementation phase as well. This is in line with other recent findings (Satheesh et al. 2022), but in addition, shows the impact in relation to contract management decisions as well as innovation. Keeping the partner’s perspective, interest and circumstances in sight, being informed and keeping the communication and coordination lines short can enhance decision-making and fairness perceptions regarding contract management. Boundary spanning as a relational feature thus shapes contractual governance mechanisms and partly affects the performance of infrastructure projects via its impact on contractual fairness.

With regard to the dependent variables, this study shows that performance and innovation are clearly two distinctively different constructs with different drivers. The independent variables in this study have different correlations with these concepts. Contractual fairness, for example, is significantly related to performance but not to
innovation. Although some might consider innovation to be an aspect of performance, this study suggests that to explain innovation in public infrastructure we have to look at different factors than those explaining performance in these projects (cf. Lember et al. 2019).

Limitations of this study include the potential risk of common method bias. Although we tried to minimize the risks thereof, we have to be careful in making generalizations. Second, measuring performance on one reflective scale has its limitations. Measuring performance of PPPs and infrastructure projects in general remains a much-debated issue in the literature (Hodge and Greve 2017). For future studies, it would be recommendable to more clearly distinguish and measure different components of performance, making a distinction in for instance cost, time and service quality performance as is often done in comparative case study research (see Petersen 2019; Verweij, van Meerkerk, and Casady 2022). Third, our data are cross-sectional and causal inferences concerning the relationships in our structural model are based on theory. Our findings show significant relationships, but longitudinal and qualitative data on public–private collaboration in infrastructure projects could provide more insight into feedback mechanisms between boundary-spanning activity, contractual fairness, and performance. Another limitation concerns the context of our study, projects in The Netherlands, which is a country with a strong collaborative tradition, also shown in comparative country research (Warsen et al. 2020). We argue that this likely does affect the level of boundary spanning activity found, but not so much its relationship with contractual fairness and innovation/performance.

The findings and limitations of this study provide various suggestions for further research into this topic. Besides the suggestions made previously to address the methodological limitations of this paper, a next step is to examine more closely different boundary spanning strategies and roles related to different phases of the project as well as going deeper into the organizational, contractual and personal antecedents that could facilitate boundary-spanning behaviour between public and private organizations (Satheesh et al. 2023; Van Meerkerk and Edelenbos 2018). In addition, we need more systematic research on how both sides of the public–private collaboration enact boundary spanning roles, what challenges they face and how contractual fairness and performance are experienced and achieved (cf. Poppo and Zhou 2014; Roehrich et al. 2020). Finally, as the Netherlands is a country with a strong collaborative tradition, it would be useful to study the role of boundary spanning activities in a range of other countries with different administrative cultures. It would be useful to study the potential effect of boundary spanning activities on performance in public infrastructure projects elsewhere. More so, it would be intriguing to see if – given the different culture – boundary spanners perform their tasks differently, whether they face similar challenges, and whether the impact on the governance of infrastructure projects remains the same.

For practitioners, this study highlights the importance of investing in boundary spanning activities in managing the relationship between public and private actors. This starts in an early phase, when the teams that work on the infrastructure project are put together but is also important during the implementation phase of projects. Organizations might want to consider the involvement of boundary spanners in their project, for example to help facilitate the exchange
of information. During the project, practitioners might want to look for organizational structures and work procedures that allow boundary spanners to cross the boundaries within and between organizations, such as easy access to various project partners. Having staff that is able to perform boundary spanning activities can help to improve the perceived fairness of the contract, and the performance and innovation of infrastructure projects. Finally, the importance of contractual fairness also shows that practitioners should discuss with their project partners how they plan to deal with the contract during the realization of public infrastructure and make informal process rules about contract management that will guide their behaviour.

Notes

1. 110 respondents filled out the survey for a DBFM project, two respondents for a DBM (Design-Build-Maintenance) project.
2. The method used for this analysis implies the existence of a causal relation between the variables. However, as this is a cross-sectional study, it is not possible to claim any causal effects with certainty. Therefore, we use more careful phrasing about relationships. The direction of the causal linkages is based on theoretical reasoning as outlined in the hypotheses.

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Disclosure statement

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