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How do contract types and incentives matter to project performance?

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Abstract

How collaborative contracts and contractual incentives might influence project performance remains equivocal. We hypothesized that their effects on project performance are mediated by owner–contractor collaboration, measured in terms of relational attitudes (relational norms and senior management commitment) and teamworking quality (inter-team collaborative processes). Using PLS-SEM, we analyzed a sample of 113 capital projects. The results suggest that through better relational attitudes and teamworking quality, projects with a partnering/alliance contract are likely to perform better than those with lump-sum and reimbursable contracts. Likewise, the projects with incentive contracts are likely to perform better than those without incentives through better relational attitudes and teamworking quality. There were no differences in project performance directly associated with different contract types and contractual incentives. Taken together, a partnering/alliance contract and incentive contracts do not necessarily result directly into better project performance but through relational attitudes and how they play out into actual teamworking behavior.

Keywords: Capital project; Collaboration; Contract; Incentive; Relational; Teamwork; Trust

1. Introduction

There is a wide agreement that the choice of contract types should be contingent upon various circumstances such as product and/or process uncertainty, desired allocation of risk, owner in-house capability, and market conditions (Merrow, 2011; Turner, 2003; Turner and Simister, 2001; Walker and Rowlinson, 2008). A proper contract type is chosen to encourage the owner and contractor to work rationally together to achieve the best outcomes in accordance to their common objectives and within the expected risk (Morris and Pinto, 2007; PMI, 2008; Smith, 2002; Turner, 2009; Walker and Rowlinson, 2008). However, two separate empirical studies at different times by CII (1986) and IPA (2010) suggest that there is no clear or direct relationship between the contract type and project performance. CII suggests that regardless of the choice of contract type, the real issues that affect the project cost performance are associated with the alignment between owner and contractor and their agreement in allocating and managing risk. In a similar vein, IPA suggests that any contract type can deliver success or failure because contract is a second-order concern. One contract type may work well for some owners but fail for others because different contract types bring different difficulties and situations.

In this study we focused on three basic types of contracts underlying the relationship between owner and contractor in the execution of capital projects: lump-sum or fixed price, reimbursable, and partnering/alliancing (Smith, 2002; Turner, 2003; Turner and Simister, 2001). A lump-sum contract is a contract where the contractor is paid a fixed amount for the whole scope of works defined in the contract. A reimbursable

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contract, commonly called cost reimbursable contract is a contract where the owner reimburses the contractor for all costs, reasonably incurred and directly associated with the amount of work done for the project; plus a certain fee (fixed fee or percentage fee) and/or an incentive fee (Berends, 2006; Merrow, 2011). A partnering/alliance contract is an extension to reimbursable contract where the owner and the contractors (often including specialist contractors and key suppliers) jointly establish the target out-turn cost and share the gain and/or pain resulting from the actual cost (Meng and Gallagher, 2012; Ross, 2003; Turner, 2003).

What is the potential influence of different contract types (partnering/alliance versus lump-sum versus reimbursable) on the nature of the relationship between owner and contractor? On one extreme, the lump-sum contract demands less owner intervention (or less involvement) and therefore offers more flexibility and less administrative burden to the contractor in executing a project (Berends, 2006; Lowe, 2007). But it also has some perceived drawbacks. A lump-sum contract is often considered to create an adversarial relationship between the parties in dealing with changes of circumstances during the project execution (Smith, 2002; Turner and Simister, 2001). The reimbursable contract, in contrast, implies that more owner involvement and support can be expected and thus less barriers to building a collaborative relationship and an integrated team (Berends, 2006; Smith, 2002). But a reimbursable contract also has some drawbacks from the one party's perspective toward the other party (Berends, 2006; Smith, 2002). The contractor often perceives that the owner will be more demanding for achieving target cost and schedule. On the other side, the owner perceives that the contractor will come up with additional work and thereby increase costs over what was initially estimated. In the end, lump sum and reimbursable contracts have a quite similar implication on owner–contractor collaboration (Müller and Turner, 2005).

On the other extreme, a partnering/alliance contract focuses on the 'principles' of relational contract to change project participants' attitudes from being short-term and adversarial toward a more collaborative mind-set and behavior (Cowan and Davies, 2003; Larson, 1995; Macbeth, 1994; Naoum, 2003; Ross, 2003; Thompson and Sanders, 1998). A partnering/alliance contract is often advocated to be more collaborative than lump-sum or reimbursable contract (Davis and Walker, 2008; Thompson and Sanders, 1998; Turner, 2003; Turner and Simister, 2001).

Several in-depth case studies of partnering/alliance practices, however, reveal that this contract type does not always eliminate the underlying adversarial attitudes. Lack of top management commitment, lack of collaborative mind-set, and insufficient initial effort to establish shared culture remain in practice (Aarseth et al., 2012; Alderman and Ivory, 2007; Bresnen and Marshall, 2002; Chan et al., 2012; Smyth and Edkins, 2007). Contemplating the practical difficulties of partnering/alliance projects, it is questionable whether a partnering/alliance contract is better than other contract types. Merrow (2011) coins a controversial view on the role of alliance contracts, "…, even if everything possible has been done to prepare the project (industrial megaprojects)… Alliance contracts … do nothing to help us understand who is responsible for what" (p.293). This contradiction provokes an important research question, to what extent do different contract types actually enact different quality of collaborative relationship between owner and contractor and in turn affect project performance?

This paper adopts Suprapto et al.'s (2015) conceptualization of owner–contractor collaborative relationship as a set of norms and the manifested interactional processes by which the project parties (owner and contractor) jointly act and decide on the issues emerging during the course of a project in order to bring mutually satisfactory project outcomes. Owner–contractor collaborative relationship includes two dimensions: (1) relational attitudes; and (2) teamworking quality. Relational attitudes refer to *norms and commitment developed and shared by the senior management from both owner and contractor to govern their project-specific relationship*. The essential elements of relational attitudes include fairness, inter-organizational trust, transparency, and no blame culture alongside the commitment of senior management to support the project teams (Cheung et al., 2006; Rahman and Kumaraswamy, 2008; Suprapto et al., 2015). Building on the works of Hoegl and colleagues (Hoegl and Gemuenden, 2001; Hoegl and Parboteeah, 2007; Hoegl et al., 2004), Salas et al. (2005), Pinto et al. (2009), and Suprapto et al. (2015) define teamworking as *a set of underlying mechanisms reflecting the task-related and social interactions between owner team and contractor team in executing a project*. They operationalize teamworking quality as a higher-order construct capturing the quality of inter-team interactions and including 5 facets of task-related interactions: *communication*, *coordination*, *balanced contribution*, *aligned effort*, and *mutual support*; and 2 facets of social interactions: *cohesion* and *affective trust.*

The efficacy of relational attitudes and teamworking quality on project performance (in terms of efficiency, effectiveness, perceived satisfaction, and perceived success) has been empirically substantiated whereas relational attitudes indirectly influence project performance through teamworking quality (Suprapto et al., 2015). Extending Suprapto et al.'s research model, we addressed the research question by examining the effects of contract types (partnering/alliance, reimbursable, and lump-sum) and contractual incentives on project performance through two mechanisms: (i) directly and (ii) indirectly through the mediation of relational attitudes and teamworking quality.

By quantifying such direct and indirect effects, this paper attempts to make three contributions. First, we extend the scope of analysis by considering the *ex-post* effects of contract types and incentives on the quality of owner–contractor relationships and project performance that have been assumed *ex-ante* and lacking empirical support. Second, by moving beyond the direct effects, this study is the first to assess potential indirect effects of contract types and incentives on project performance through the parties' relational attitudes and their inter-teamworking quality. Third, the findings provide explanation to which contract type is better than the others toward project performance and what mechanisms are underlying it.

The paper is structured as follows. Section 2 presents the theoretical background on the relationships between contract types, contractual incentives, relationship quality, and project

performance. Section 3 describes the research methodology used to test the hypotheses. Section 4 presents the results and finally Section 5 discusses the implications and future research directions.

2. Conceptual framework

2.1. Collaborative contracting in engineering and construction projects

Literature on inter-organizational relationships and alliances often distinguish governance modes in terms of equity and non-equity (or contractual based) alliances (Gulati, 1995) in the context of R&D alliances (Feller et al., 2013), buyer–supplier (Zaheer et al., 1998), and new business ventures (Faems et al., 2012). In capital projects, one-off creations of complex physical assets, the relationships between the owners and the contractors are generally, if not always, on contractual basis. Contract types known and used within engineering and construction industry like lump-sum, reimbursable, and partnering/alliance are the more specific forms of non-equity alliances.

Conceptually, the choice of contract type depends upon a number of factors known *ex-ante*: initial trust and commitment that emerged from a prior relationship (Gulati, 1995; Poppo et al., 2008), perceived risks and uncertainty as a function of scope definition (Gopal et al., 2003; Smith, 2002; Turner, 2003; Turner and Simister, 2001), and external factors like regulatory challenges, market volatility, and difficulties due to location (Berends, 2007; Merrow, 2011). A contract in project context is *ex-ante* designed to align the owner's and contractor's goal (Turner, 2003). However, the inherent complexity, scope and scale, and the long time duration make capital projects susceptible to future uncertainties and turbulence (Drexler and Larson, 2000; Hartmann and Marshall, 2011; Miller and Lessard, 2000; Sanderson, 2012). As a consequence, any new risks and unforeseen events may arise as the project progresses which in turn causes potential disputes and breakdown of the relationship. To cope with such threats, the parties need to build stronger, more collaborative and more flexible relationships on the basis of consciously designed *ex-post governance* mechanisms (Miller and Lessard, 2000; Sanderson, 2012; Turner, 2003; Winch and Maytorena, 2011).

Prior studies in project-based collaboration, however, also reveal that the presumed governability is often not realized to the extent expected (Alderman and Ivory, 2007; Bresnen and Marshall, 2002; Gil, 2009). Relationships in projects also involve problems associated with competing cultures and rationalities in day-to-day practice among project team members. This in turn necessitates "relational contracting" emphasizing on ongoing adaptations, reciprocity and interdependence, avoidance of detrimental behavior, mutual trust, and communication openness between the parties and the teams (Gil, 2009; McLennan and Scott, 2002; Müller and Turner, 2005; Smyth and Pryke, 2008).

Building on the aforementioned literature, we assume that the function of a contract in capital projects is to serve as *legally binding*, *enforceable*, *and reciprocal commitment governing the collaboration between owner and contractor* (Berends, 2015; Turner, 2003). We focus on the *ex-post governing* effect (after contract award) of the choice of contract type on the owner–contractor collaboration and the project performance.

We consider two related concepts: relational attitudes and teamworking quality specified by Suprapto et al. (2015) as the basis for defining owner–contractor collaboration. Suprapto et al. conceptualize and empirically validate relational attitudes and teamworking quality as two higher order constructs that capture the complex nature of owner and contractor collaborative relationship at inter-firm and inter-team levels respectively. The underlying concept of the relational attitudes is that when an owner and a contractor work collaboratively in a project, the relationship between the two firms is characterized by a high degree of reciprocal attitudes such as mutual trust and respect, commitment and leadership, no blame culture, and communication openness between senior management from both sides (Meng, 2011; Pinto et al., 2009; Rahman and Kumaraswamy, 2008; Smyth et al., 2010; Suprapto et al., 2015; Young and Poon, 2013). At the project team level, highly collaborative teams display behaviors related to seven facets of teamworking quality. Team members in teams with high teamworking quality openly communicate relevant information, continuously coordinate their activities, contribute their knowledge and expertise to their full potential, mutually support each other in anticipating unforeseen events, and align their efforts to expected priority (Hoegl and Gemuenden, 2001; Suprapto et al., 2015). Teams with high teamworking quality also possess cohesiveness ('we-ness') (Hoegl and Gemuenden, 2001; Suprapto et al., 2015) and affective trust among team-members (Pinto et al., 2009; Suprapto et al., 2015).

2.2. Contract types, incentives and collaborative relationship

Project management scholars distinguish traditional contract types into traditional contracts (like lump-sum and reimbursable contracts), and relational contracts (like partnering or alliance). Under a lump-sum contract, the owner assumes certainty of the project scope in terms of the functionality and performance specifications. The contractor is expected to implement the best solution and method of delivery to meet the specified functionality and performance specifications (Smith, 2002; Turner, 2003). Because all project activities and the associated risks are expected to be managed by the contractor, the owner has less direct need to follow up on project progress assuming the project proceeds according to the defined scope (Berends, 2007; Müller and Turner, 2005). This leads to the decrease in the owner's involvement in the project leading to limited information exchange and coordination (Merrow, 2011; Müller and Turner, 2005).

A reimbursable contract including the variants like cost plus a fixed or percentage fee, assumes the project definition is more uncertain (Berends, 2006; IPA, 2010; Merrow, 2011; Turner, 20). Under a reimbursable contract, the contractor is paid for his efforts with all risks taken by the owner (Müller and Turner, 2005; Smith, 2002; Turner, 2003). It is often perceived by the owner that the contractor is attracted to over-supply to gain more profit (Müller and Turner, 2005). This encourages the

owner to assign a much larger team to perform extensive control and monitoring over the progress and quality of the contractor's work (Berends, 2007; Merrow, 2011). The close interaction between owner team and contractor team during the course of the project, however, does not necessarily mean a better collaboration (Müller and Turner, 2005).

A partnering/alliance contract is a particular form of reimbursable contract where the goals of the contractor are aligned to those of the owner through target cost and a gain-sharing (in alliance contract this includes pain-sharing; Ross, 2003) mechanism (Bennet and Peace, 2006; Scott, 2001; Thomas and Thomas, 2005). Partnering/alliance contract is built on relational contracting aiming to facilitate owner–contractor collaboration with a common set of goals, norms of trust and respect, and clear procedures for joint risk management and dispute resolution (Beach et al., 2005; Larson, 1995; Naoum, 2003; Scott, 2001). With a partnering/alliance contract, the collaboration between owner and contractor can be further enhanced through a joint project governance board and integrated project team to ensure effective teamwork to achieve better project results (Beach et al., 2005; Davis and Walker, 2008; McLennan and Scott, 2002; Ross, 2003).

Linking the characteristics of contract types to the owner–contractor collaborative relationships, we proposed that different contract types may influence the senior management from both owner and contractor to develop and share a different degree of relational attitudes (relational norms and commitment) in order to govern their relationship *ex-post* during the project execution.

H1. Partnering/alliance contracts for projects are likely to display better relational attitudes toward collaboration than (a) lump-sum or (b) reimbursable contracts.

Likewise different contract types imply different degree of teamworking (task-related and social interactions) between owner team and contractor team when performing interdependent tasks. Controlling for the effect of relational attitudes, we hypothesized:

H2. Partnering/alliance contracts for projects are likely to display better teamworking quality than (a) lump-sum or (b) reimbursable contracts.

Independent of the remuneration schemes, incentive provisions can be incorporated into any contract. There are four types of incentive schemes: (a) cost incentives, (b) schedule incentives, (c) performance incentives, and (d) safety incentives (Bubshait, 2003; Herten and Peeters, 1986). It is also not uncommon to have multiple-incentives, where two or more of these incentives are combined into the same contract (Lowe, 2007). Within industrial project practitioners, Bubshait (2003) finds a general agreement among respondents on the effectiveness of incentive contracts in encouraging the contractor performance. Based on a case study of three collaborative projects with differing contracting strategies, Berends (2006) also reached the same conclusion that incentive schemes enhanced the alignment of owner and contractor objectives. Similarly, Meng and Gallagher (2012) find that the use of incentive schemes can increase the contractor's awareness of improvement, which in turn leads to much greater emphasis on the collaborative working relationship. Building on the aforementioned studies' findings, we hypothesized:

H3. Incentive-based contracts for projects are likely to display better relational attitudes toward collaboration than non-incentive contracts.

H4. Incentive-based contracts for projects are likely to display better teamworking quality than non-incentive contracts.

2.3. Contract types, incentives, and project performance

It is often suggested that a more collaborative contract, i.e.: partnering/alliance contract leads to better construction performance than traditional contracts like lump-sum or reimbursable contract (Bennet and Peace, 2006; ECI, 2003; Thompson and Sanders, 1998). However, upon a sample of 318 industrial megaprojects, Merrow (2011) shows that the success of projects executed with alliance contract was not better than those with lump-sum or reimbursable contract. A survey study by Meng and Gallagher (2012) in the UK construction firms also suggests that the performance (in terms of cost, schedule, and quality) of construction projects did not significantly associate with contract types (ranging from fixed price to cost plus fee).

Analyzing the historical development of the UK defense procurement, Parker and Hartley (1997) show that a partnering/alliance contract does not necessarily lead to superior results compared to traditional contracting. Likewise, a number of case studies suggest that a partnering/alliance contract does not always eliminate the underlying adversarial attitude between owner and contractor (Aarseth et al., 2012; Alderman and Ivory, 2007; Bresnen and Marshall, 2002; Chan et al., 2012; Ng et al., 2002). In line with this view, Lowe (2007) posits that the performance of a project depends upon the relationships between the parties and not by and large on the contract. Some scholars argue that different contract types have a different consequence on the degree of owner and contractor collaboration which ultimately might influence project performance (Berends, 2007; Meng, 2011; Müller and Turner, 2005). Müller and Turner (2005), for example, postulate that lump-sum and reimbursable contracts, compared to partnering/alliance contract, tend to create a situation in which the owner and the contractor do not consider the need to align their interests. As a result the owner–contractor collaboration becomes limited and eventually leads to lower project performance. Recent study by Suprapto et al. (2015) has empirically substantiated the positive effect of the owner–contractor collaboration, in terms of relational attitudes and teamworking quality, on project performance. Hence, it is arguable that the performance of the projects executed with partnering/alliance contract is likely to be better than those with lump-sum or reimbursable contract as the parties are able to work together more collaboratively. We hypothesized:

H5. Partnering/alliance contracts for projects, through the more positive relational attitudes and teamworking quality, are likely to perform better than (a) lump-sum or (b) reimbursable contracts.

Contrary to a common belief that incentive schemes might have positive effect (Berends, 2006; Bubshait, 2003; Herten and Peeters, 1986), Merrow (2011) finds that contractual incentives do not have any effects on project success. The success rate of projects with incentives, although not statistically significant, was lower than those without incentives. The assumption that there is a great deal of financial gain (incentives) to be saved through efficient execution is a flawed idea. Merrow argues that execution is about to achieve the targeted value (cost and schedule) that has been created and not to create new value. But it would be a mistake to believe that incentives must always have a negative effect on performance or make that the contractor cannot be motivated by both additional financial rewards and interest in the work itself. It might be that the use of incentive schemes does not directly affect project performance, but at a minimum, they can work under certain circumstances. Explicit incentive schemes are designed to align the financial interests of the contractor with those of the project goals (Berends, 2006; Bubshait, 2003; Meng and Gallagher, 2012). Because achieving the project goals better is also improving their commercial success (better profit), the contractor is more motivated to focus their effort in managing and controlling factors that influence the team productivity which is critical for achieving project duration and/or project cost (Bubshait, 2003). In the end, the effect of contractual incentive on project performance can be explained by this indirect mechanism: the aligned interests of owner and contractor ensure the attention on effective teamworking, which in turn, enhances the project performance (Meng and Gallagher, 2012). We therefore hypothesized:

H6. Incentive-based contracts for projects, through the more positive relational attitudes and teamworking quality, are likely to perform better than non-incentive contracts.

An integrative conceptual model shown in Fig. 1 brings all the above hypotheses together. The conceptual model applies a mediation structure with contract types and contractual incentives as independent variables, relational attitudes and teamworking quality as serial mediators and project performance as dependent variable. We cannot justify theoretically the hypotheses regarding the direct effects of contract types and contractual incentives on project performance but we explore these direct effects in the analyses.

3. Research methodology

3.1. Data collection

The study population consisted of practitioners who have been involved in the execution of capital projects within the Dutch Process Industry Competence Network (NAP-Netwerk). This network brings together more than 120 organizations from the entire value chain in the Dutch process industry, including asset owners, engineering and construction firms, suppliers, consulting firms, and universities/research institutions. We

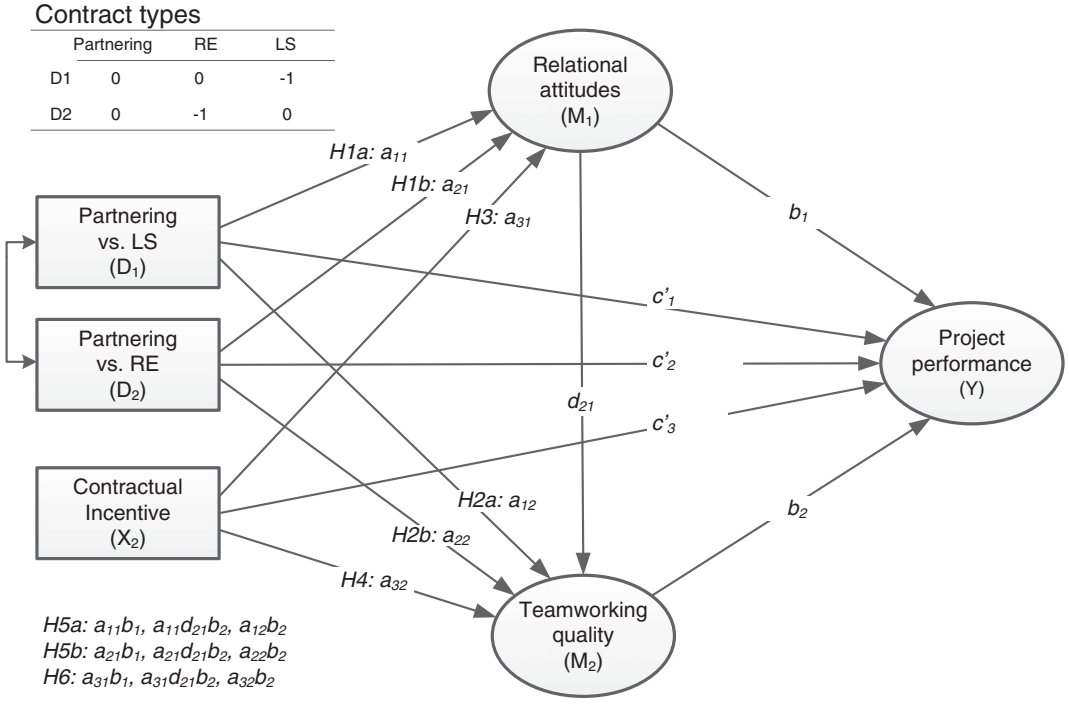

Fig. 1. Research model: contract type, relationship quality, and performance.

invited around 450 practitioners to participate in an online questionnaire during a period from October to December 2013. The response rate was 26.4% with 119 completed responses. Due to strict anonymity reason, we were unable to exercise follow-up calls to assess non-responders. As the proxy to assess potential non-response bias, we follow two methods of Lindner, Murphy, and Briers (2001): (1) the comparison of early to late respondents (t-test) and (2) using 'days to respond' as the predicator to regression equations of the main constructs. The results indicate that neither the mean difference of the constructs between early and late respondents nor the 'days to respond' are significantly different.

After cleansing the responses with more than 15% missing values, we have 113 responses. Among this dataset, there are 1.45% missing values of the total number of values. Little's MCAR test (Little and Rubin, 2002) suggests that the missing values were missing completely at random ($X^2 = 4066.93$; $df = 3963$; $sig = 0.122$). This suggests no hidden systematic pattern of missing values and thus any imputation method could be used (Hair. et al., 2010). We then applied the regression imputation method to replace the missing values in the dataset.

The sample varied widely in type of industry, type and size of projects, and type of respondents. The majority of the respondents were project directors (19.5%), project managers (46%), and team leaders/managers (24.8%) and the rest were functional managers and project board members (9.7%). With regard to the company's role, 41.6% of the respondents represented owner companies, and 58.4% represented contractors. In terms of industry, the majority of the projects were in oil, gas, and petrochemicals (60.4%); the rest were in civil construction (8%), infrastructure, power, and utilities (10.6%), food and consumer products (7.1%), electronics, ICT, and semiconductors (3.5%), pharmaceuticals (2.7%), and manufacturing (2.7%). In terms of total project costs, 10.6% were up to €1 million, 30.1% were €1–10 million, 25.7% were €10–100 million, 24.8% were €100–1000 million, and 8.8% were more than €1 billion. Finally, in terms of contract types, 54.0% were lump-sum, 33.6% were reimbursable, and 12.4% were partnering/alliance.

3.2. Method

We applied partial least square structural equation modeling (PLS-SEM) to test our research model. We choose PLS-SEM in this study due to the following reasons. First, PLS-SEM is suggested over covariance-based SEM (CB-SEM) when analyzing research models that are in exploratory stage or an extension of an existing structural theory (Hair et al., 2013b; Reinartz et al., 2009). Because the underlying theory of our research model is still 'less developed', PLS-SEM is the appropriate approach. Secondly, PLS-SEM exhibits higher statistical power than CB-SEM when used in complex models with smaller sample size (Hair et al., 2012, 2013a; Reinartz et al., 2009). Hair et al. (2012, 2013a) recommend a minimum sample size of 10 times the maximum number of paths aiming to endogenous constructs. This study's sample size, 113 observations was relatively small but still above the minimum 100 samples (10 times 10 paths directed at the construct project performance). Post-hoc statistical power analysis also indicated that our sample size was above the commonly accepted threshold of 0.8 (Hair et al., 2013a). Finally, previous research had shown that the PLS-SEM algorithm transforms non-normal data in accordance with the central limit theorem (Hair et al., 2013a, 2013b). This makes PLS-SEM results robust when using skewed data and formative measures (Rigdon et al., 2010; Ringle et al., 2009).

3.3. Statistical model

Because our hypotheses entail the comparison of three different contract types (lump-sum, reimbursable, and partnering/alliance contracts), there is no single path coefficient that represents the contract type's effect on the mediators or project performance. We followed Hayes and Preacher's (2014) guideline on statistical mediation analysis with multi-categorical independent variable. The contract types can be transformed into k–1 dummy variables or 2 (k = 3 is the number of contract types) dummy variables D_1 and D_2. D_1 codes the lump-sum contract, D_2 codes the reimbursable contract, and the partnering/alliance contract serves as the reference group and receives a code of 0 on both D_1 and D_2 (see Fig. 1). The double-headed arrow connecting D_1 and D_2 in Fig. 1 indicates that the two variables should always be simultaneously included in the analysis. Using these codes for contract types, the mediation model can be parameterized with three equations:

$$M_1 = i_{11} + a_{11}D_1 + a_{21}D_2 + a_{31}X_2 + e_{M_1} \quad (1)$$

$$M_2 = i_{12} + a_{12}D_1 + a_{22}D_2 + a_{32}X_2 + d_{21}M_1 + e_{M_2} \quad (2)$$

$$Y = i_2 + c'_1D_1 + c'_2D_2 + c'_3X_2 + b_1M_1 + b_2M_2 + e_Y \quad (3)$$

for relational attitudes (M_1), teamworking quality (M_2), and project performance (Y) respectively where X_2 is contractual incentive; i_{11}, i_{12}, and i_2 are constants; e_{M_1}, e_{M_2}, and e_Y are error terms.

Estimation of Eq. (1) yields three coefficients quantifying differences between the contract types and incentive on *relational attitudes* (a_{11}, a_{21}, and a_{31} or H1a, H1b, and H3 respectively). Eq. (2) estimates three coefficients quantifying differences between the contract types and incentive on *teamworking quality* (a_{12}, a_{22}, and a_{32} or H2a, H2b, and H4 respectively) and one coefficient quantifying the effect of relational attitudes on teamworking quality (d_{21}). Eq. (3) estimates three coefficients quantifying the mean group differences in project performance due to contract types (c'_1 and c'_2) and contractual incentive (c'_3) holding both relational attitudes and teamworking quality constant. These three coefficients, also called *relative direct effects*, correspond to H5a, H5b, and H6, i.e.: the relative direct effects of reimbursable (c'_1) and partnering/alliance contract (c'_2) on project performance over lump-sum contract, and the relative direct effect of incentive-based contract on project performance over non-incentive contract (c'_3).

Eq. (3) also estimates two coefficients quantifying the effects of relational attitudes and teamworking quality on

project performance (b_1 and b_2) while statistically equating the groups on average on contract type. Taking into account all coefficients estimated from Eqs. (1), (2), and (3); we can estimate the *relative indirect effects* of contract types and incentive on project performance through relational attitudes and teamworking quality. H5a corresponds to the relative indirect effect of a partnering/alliance contract on project performance over lump-sum contract through relational attitudes and teamworking quality and is captured by three specific indirect effects: $a_{11}b_1$ ($D_1 \rightarrow M_1 \rightarrow Y$), $a_{11}d_{21}b_2$ ($D_1 \rightarrow M_1 \rightarrow M_2 \rightarrow Y$), and $a_{12}b_2$ ($D_1 \rightarrow M_2 \rightarrow Y$). H5b or the relative indirect effect of partnering/alliance contract on project performance over reimbursable contract is captured in $a_{21}b_1$ ($D_2 \rightarrow M_1 \rightarrow Y$), $a_{21}d_{21}b_2$ ($D_2 \rightarrow M_1 \rightarrow M_2 \rightarrow Y$), and $a_{22}b_2$ ($D_2 \rightarrow M_2 \rightarrow Y$). In a similar manner, the *relative indirect effect* of contractual incentive on project performance through relational attitudes and teamworking quality (H6) is captured by $a_{31}b_1$ ($X_2 \rightarrow M_1 \rightarrow Y$), $a_{31}d_{21}b_2$ ($X_2 \rightarrow M_1 \rightarrow M_2 \rightarrow Y$), and $a_{32}b_2$ ($X_2 \rightarrow M_2 \rightarrow Y$).

For each independent variable (D_1, D_2, or X_2), summing up its relative direct effect and three specific indirect effects is equal to its relative total effect (c_i) on project performance. For example, the relative total effect of partnering/alliance over lump-sum contract on project performance is $c_1 = c'_1 + a_{11}b_1 + a_{11}d_{21}b_2 + a_{12}b_2$.

3.4. Measures

Most of the key constructs were measured through multi-item scales. We relied on existing measurement scales that have been validated in prior research. All items were designed with responses on a five-point scale ranging from 1 (representing a zero of the trait; e.g., not satisfied at all) to 5 (representing a perfectly positive assessment of the trait; e.g., completely satisfied). All measurement items are listed in full in Appendix 1.

We followed Merrow's (2011) basic forms of contract and used three categories of contracts: *lump-sum*, *reimbursable*, and *partnering/alliance*. Lump-sum contract includes the variants like convertible lump-sum, and provisional lump-sum. Reimbursable contract also includes unit rate or schedule rate and any cost plus contracts. Partnering/alliance contract includes both partnering and alliancing contracts. Contractual incentive was operationalized as a categorical variable and reflects whether or not the contract includes any explicit incentive schemes.

Relational attitudes were operationalized as a higher-order construct consisting of 2 first-order reflective constructs: *senior management commitment* and *relational norms*. The measures for these constructs have been developed by Suprapto et al. (in press) with 3 items for senior management commitment (i.e.: commitment to provide resources and support, leadership, active involvement in resolving conflict) and 5 items for relational norms (i.e.: aligned interests and objectives, mutual trust, no blame culture, and openness).

Teamworking quality was operationalized as a higher-order construct consisting of 7 first-order reflective constructs: *communication*, *coordination*, *cohesion*, *balanced contribution*, *aligned effort*, *mutual support*, and *affective trust*. The first 6 constructs used reflective scales adapted by Hoegl and colleagues (Hoegl and Gemuenden, 2001; Hoegl and Parboteeah, 2007; Hoegl et al., 2004). The affective trust construct used reflective scales adapted from Lau and Rowlinson (2011), Pinto et al. (2009), and Silva et al. (2012). In total, there were 27 items to measure teamworking quality: communication (4 items), coordination (4 items), cohesion (4 items), balanced contribution (3 items), aligned effort (3 items), mutual support (3 items), and affective trust (6 items).

Project performance was operationalized as a formative construct of 4 items. The first measurement item was an index of performance reflecting project efficiency and effectiveness indicators, i.e.: *cost*, *schedule*, *quality*, *safety*, and *operability* performance. This index was calculated as an average value of the five indicators weighted by their relative importance in the eye of respondents. The other three distinct items were *perceived satisfaction on the overall results*, *perceived business success to owner*, and *perceived commercial success to contractor* (Hoegl and Gemuenden, 2001; Pinto et al., 2009).

Finally, we included five control variables: perceived *front-end definition*, *project size*, *firm size*, *prior relationship duration*, and *early contractor involvement* to control for potential confounders. The first three control variables are also considered as the proxy to characterize the complexity factors (Bosch-Rekveldt et al., 2011). The perceived front-end definition includes four reflective items adapted from Merrow's (2011) *front-end loading* criteria: the perceived clarity of the project goals, clarity of the project scope, quality of the basic design and quality of the execution plan. The project size was measured with two reflective items, the project duration and total installed cost. The firm size was measured with two reflective items, the firm's number of employees and annual turnover. Prior relationship duration refers to number of years in which the owner and the contractor had been working in the previous projects. Finally, the contractor's early involvement variable reflects whether the contractor was already involved during the front-end development stage of the project.

4. Results

We used SmartPLS 2.0 (Ringle et al., 2005) to estimate the measurement models and the structural models. In evaluating and reporting the results, we followed the recent guidelines of PLS-SEM by Chin (2010) and Hair et al. (2012, 2013a, 2013b), and thoroughly assessed the measurement models before evaluating the structural model.

4.1. Measurement models

As indicated in Section 3.4, our measurement models consist of two types of latent constructs, i.e.: 11 reflective constructs and 1 formative construct. Each type of construct requires different evaluation criteria. Hair et al. (2013a; 2013b) recommend that all reflective constructs should be evaluated against (a) *indicator reliability* (indicator loadings ≥ 0.70), (b) *internal consistency reliability* (Cronbach's alpha and composite reliability ≥ 0.70),

(c) *convergent validity* (AVE — average variance extracted ≥ 0.50), and (d) *discriminant validity* (Fornell–Larcker criterion). For formative constructs, Hair et al. recommend to assess (a) *the statistical significance* or the *relevance of the indicators* (significant relative weight or indicator loadings ≥ 0.50), and (b) *multicollinearity among indicators to identify/remove potential redundancy* (variance inflation factors among indicators — VIFs < 5.0).

The assessment of the measurement models indicates that all 11 reflective constructs are completely satisfactory. First, all 41 reflective indicators reach sufficient levels of indicator reliability as all indicators' loadings on their corresponding constructs are above 0.707 (Appendix 1). Second, all reflective constructs also satisfy internal consistency reliability as all constructs' Cronbach's alpha and composite reliability are equal and above 0.708 and 0.868 respectively (Appendix 1). Third, all reflective constructs achieve convergent validity as the AVE values surpass the 0.5 level (Appendix 1). Finally, the Fornell–Larcker criterion analysis shows that all reflective constructs attain discriminant validity as the square roots of AVE of all reflective constructs (the diagonal elements) are larger than their inter-correlations (the off-diagonal elements) (see Appendix 2).

The assessment of the formative construct, project performance, indicates that 2 indicators do not have significant relative weights, however, all loadings are above 0.5 (see Appendix 1). Through multiple regressions, we obtained the average VIF values of the four formative indicators ranging from 1.424 to 2.503. VIF values are below the threshold value of 5 thus multicollinearity is not an issue. Overall, all 4 indicators attain the formative criteria.

4.1.1. Common method variance

Because the data came from single respondents in a one-time survey, common method variance (CMV) might influence some hypothesized relations in the PLS path model. To test for the potential existence of common method variance, we applied Harman's (1976) single-factor test. The first factor accounts for only 35.4% of the overall variance, which indicates that common method variance unlikely affects the results (Podsakoff and Organ, 1986). Because this traditional test suffers some limitations, we also adopted the marker variable approach (Podsakoff et al., 2003; Richardson et al., 2009; Williams et al., 2010). More specifically, we applied Rönkkö and Ylitalo's (2011) PLS marker approach. Using a marker variable with six indicators, we estimated the method variance correlation by calculating a mean of the correlations between the marker indicators and the study indicators. The mean correlation is 0.03 which is smaller than the suggested threshold of 0.05 and indicates that the common method variance has a negligible effect (Rönkkö and Ylitalo, 2011). To ensure this, we ran the baseline model both without the marker variable and with the marker variable (with paths to all endogenous constructs). A comparison of the results shows trivial differences (ranging from 0.002 to 0.021) on all path coefficients and no changes in their level of statistical significance. We therefore continued the PLS analysis without the marker variable.

4.1.2. Potential endogeneity bias

Like most empirical studies on inter-firm alliances in strategic management literature (Hamilton and Nickerson, 2003), our research model is analogous to the performance effect of the strategic choice model with discrete strategies (contract types) and continuous performance outcomes (the degree collaboration and project performance). The contract choice was decided by managers based on known *ex-ante* factors such as the perceived uncertainty, complexity, and therefore risks of the project (Berends, 2007; Lowe, 2007; Merrow, 2011; Smith, 2002), trust and norms that arise from expectation of continuity (Poppo et al., 2008) and prior relationship (Gulati, 1995; Lui and Ngo, 2004), and the parent firm's capability (Hamilton and Nickerson, 2003). To control for these known *ex-ante* factors, we included in the PLS-SEM structural model five control variables: the perceived front-end definition, project size, firm size, prior relationship duration, and early contractor involvement. Still, senior managers' decision on contract type is also affected by their expectation of the outcomes due to some other factors unobserved that may actually drive the outcomes. In economics and strategic management literature this is also called 'self-selection bias' (Antonakis et al., 2010; Hamilton and Nickerson, 2003). To check whether this endogeneity biases the accuracy of the structural model, we performed the Heckman's (1976, 1979) two-step procedure to control for endogeneity bias (similar to the approach performed by Gopal et al., 2003). Specifically, in the first stage we applied Heckman's probit model for predicting the binary variable contractual incentives, and Lee's (1983) multinomial logit model for multi-categorical variable contract type. In both models we included the aforementioned control variables and five additional instrumental variables as predictors. The instrumental variables are *the perceived technological risk*, *regulatory challenges*, *market volatility*, *location remoteness*, and *pressure* from *external stakeholder* that might affect contract choice but do not directly impact the endogenous constructs (relational attitudes, teamworking quality, and project performance). We then calculated the *Inverse Mills Ratio* for contractual incentives (IMR_{IC}) and contract type (IMR_{CT}) as endogeneity bias correction variables. In the second stage, we included IMR_{IC} and IMR_{CT} into the structural models for predicting the endogenous constructs and applied bootstrapping to obtain the corrected standard error and coefficient estimates. The results suggest that the coefficients of the IMR_{IC} and IMR_{CT} for all three endogenous regression models are not significantly different from zero. Hence the potential endogeneity bias is not a concern. We continue the analyses of the PLS structural model without correcting for endogeneity bias.

4.2. Structural model

We performed a two-step analysis to provide a detailed picture of all hypotheses testing. In the first step, we focused on

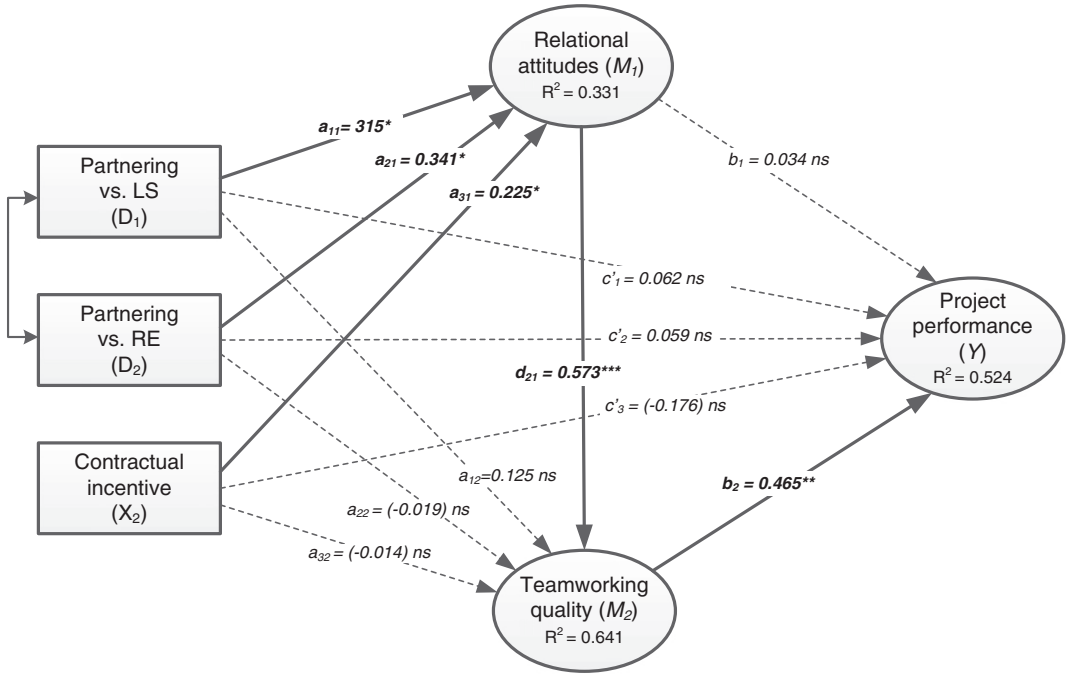

Fig. 2. Structural model diagram. Note: all path coefficients are unstandardized; *sig. at $p < 0.05$; **sig. at $p < 0.01$; ***sig. at $p < 0.001$; ns = not significant; control variables are not shown; based on bootstrapping of 10,000 subsamples.

the PLS-SEM structural model that estimates the direct path coefficients between all constructs (hypotheses 1 to 4; see Fig. 2 and Table 1). Subsequently, in step 2, we performed statistical mediation analysis (Hayes, 2013; Hayes and Preacher, 2014) to assess the indirect effects of contract types and incentives on project performance mediated by relational attitudes and teamworking quality (hypotheses 5 and 6; see Table 2). We also included five control variables: front-end definition, project size, firm size, prior relationship duration, and early contractor involvement. The significance of all path

Table 1
Unstandardized paths coefficients.

Relation	Outcome													
To	Relational attitudes (M_1)					Teamworking quality (M_2)					Project performance (Y)				
From		Coeff.		SE	p		Coeff.		SE	p		Coeff.		SE	p
Constant	i_{11}	1.873	***	0.343	0.000	i_{12}	0.738	***	0.222	0.001	i_2	0.279	ns	0.424	0.512
PAL vs. LS (D_1)	a_{11}	0.315	*	0.148	0.036	a_{12}	0.125	ns	0.095	0.193	c'_1	0.062	ns	0.144	0.666
PAL vs. RE (D_2)	a_{21}	0.341	*	0.161	0.037	a_{22}	−0.019	ns	0.106	0.856	c'_2	0.059	ns	0.156	0.708
RE vs. LS (D_1–D_2)[a]	a_{12}–a_{21}	−0.026	ns	0.118	0.827	a_{12}–a_{22}	0.144	ns	0.083	0.084	c'_1–c'_2	0.004	ns	0.115	0.973
Contractual incentive (X_2)	a_{31}	0.225	*	0.111	0.045	a_{32}	−0.014	ns	0.077	0.856	c'_3	−0.176	ns	0.109	0.109
Relational attitudes (M_1)						d_{21}	0.573	***	0.098	0.000	b_1	0.034	ns	0.148	0.820
Teamworking quality (M_2)											b_2	0.465	**	0.175	0.009
Control variables:															
Front-end definition	f_1	0.419	***	0.083	0.000	g_1	0.139	ns	0.070	0.051	h_1	0.391	***	0.086	0.000
Project size	f_2	0.022	ns	0.033	0.511	g_2	−0.011	ns	0.018	0.544	h_2	−0.030	ns	0.037	0.417
Firm size	f_3	0.026	ns	0.039	0.505	g_3	0.057	*	0.025	0.027	h_3	0.049	ns	0.043	0.256
Prior relationship	f_4	0.004	ns	0.005	0.391	g_4	0.002	ns	0.003	0.506	h_4	−0.005	ns	0.005	0.318
Early contractor involvement	f_5	−0.030	ns	0.106	0.781	g_5	0.086	ns	0.068	0.210	h_5	−0.148	ns	0.100	0.142
Predictive relevance	R^2 = 0.331; R^2_{adj} = 0.280					R^2 = 0.641; R^2_{adj} = 0.610					R^2 = 0.524; R^2_{adj} = 0.477				
Omnibus test	$F(8,104)$ = 9.650, $p < 0.001$					$F(9,103)$ = 28.108, $p < 0.001$					$F(10,102)$ = 12.813, $p < 0.001$				

Note: PAL = partnering/alliance contract; RE = reimbursable contract; LS = lump-sum contract; ns = not significant.
* Significant at $p < 0.05$ based on bootstrapping of 10,000 subsamples.
** Significant at $p < 0.01$ based on bootstrapping of 10,000 subsamples.
*** Significant at $p < 0.001$ based on bootstrapping of 10,000 subsamples.
[a] Estimated separately by changing the reference category to RE.

Table 2
Relative total, direct, and indirect effects of contract types and contractual incentive.

	Relative total effect				Relative direct effect				Relative indirect effect			
											95% BCB-CI	
		Coeff.	SE	p		Coeff.	SE	p	Coeff	SE	LL	UL
PAL vs. LS (D_1)	c_1	0.215 ns	0.150	0.155	c'_1	0.062 ns	0.134	0.666				
					Total indirect effect: c_1–c'_1				0.152 sig.	0.065	0.047	0.306
					Ind1 ($D_1 \rightarrow M_1 \rightarrow Y$): $a_{11}b_1$				0.011 ns	0.045	−0.057	0.136
					Ind2 ($D_1 \rightarrow M_1 \rightarrow M_2 \rightarrow Y$): $a_{11}d_{21}b_2$				0.084 sig.	0.046	0.019	0.222
					Ind3 ($D_1 \rightarrow M_2 \rightarrow Y$): $a_{12}b_2$				0.058 ns	0.051	−0.011	0.192
PAL vs. RE (D_2)	c_2	0.152 ns	0.159	0.343	c'_2	0.059 ns	0.156	0.708				
					Total indirect effect: c_2–c'_2				0.093 ns	0.077	−0.041	0.265
					Ind1 ($D_2 \rightarrow M_1 \rightarrow Y$): $a_{21}b_1$				0.012 ns	0.048	−0.063	0.146
					Ind2 ($D_2 \rightarrow M_1 \rightarrow M_2 \rightarrow Y$): $a_{21}d_{21}b_2$				0.091 sig.	0.052	0.017	0.239
					Ind3 ($D_2 \rightarrow M_2 \rightarrow Y$): $a_{22}b_2$				−0.009 ns	0.050	−0.112	0.088
RE vs. LS (D_1–D_2)[a]	c_1–c_2	0.063 ns	0.129	0.625	c'_1–c'_2	0.004 ns	0.115	0.973				
					Total indirect effect: (c_1–c'_1)–(c_2–c'_2)				0.059 ns	0.056	−0.044	0.179
					Ind1 (D_2–$D_1 \rightarrow M_1 \rightarrow Y$): ($a_{11}$–$a_{21}$)$b_1$				−0.001 ns	0.017	−0.051	0.023
					Ind2 (D_2–$D_1 \rightarrow M_1 \rightarrow M_2 \rightarrow Y$): ($a_{11}$–$a_{21}$)$d_{21}b_2$				−0.007 ns	0.030	−0.074	0.048
					Ind3 (D_2–$D_1 \rightarrow M_2 \rightarrow Y$): ($a_{12}$–$a_{22}$)$b_2$				0.067 sig.	0.045	0.003	0.190
Contractual incentive (X_2)	c_3	−0.115 ns	0.121	0.341	c'_3	−0.176 ns	0.101	0.109				
					Total indirect effect: c_3–c'_3				0.061 ns	0.055	−0.035	0.174
					Ind1 ($X_2 \rightarrow M_1 \rightarrow Y$): $a_{31}b_1$				0.008 ns	0.035	−0.035	0.110
					Ind2 ($X_2 \rightarrow M_1 \rightarrow M_2 \rightarrow Y$): $a_{31}d_{21}b_2$				0.060 sig.	0.034	0.010	0.155
					Ind3 ($X_2 \rightarrow M_2 \rightarrow Y$): $a_{32}b_2$				−0.007 ns	0.035	−0.070	0.071

Note: PAL = Partnering/alliance contract; RE = Reimbursable contract; LS = Lump-sum contract; M_1 = relational attitudes; M_2 = teamworking quality; Y = project performance; ns = not significant, sig. = significant based on 95% bias-corrected bootstrap confidence interval (95% BCB-CI).
[a] Estimated separately by changing the reference category to RE.

coefficients were assessed through *bootstrapping* with 113 cases, 10,000 subsamples and *no sign changes option* (Hair et al., 2013a, 2013b).

The central criterion for the structural model's assessment (Henseler and Sarstedt, 2012), namely the coefficient of determination R^2 explains the variation in the endogenous constructs. As shown in Fig. 2, the structural model accounts for 33.0% of the variance in relational attitudes, 64.1% of the variance in teamworking quality, and 52.4% of the variance in project performance. These R^2 values substantiate the model's predictive validity (Hair et al., 2013a, 2013b). This finding is also supported by the Q^2 value of the predictive relevance. After running the *blindfolding procedure* (Henseler et al., 2009), we obtained the Q^2 values of 0.540, 0.458, and 0.277 for relational attitudes, teamworking quality, and project performance respectively. All Q^2 values are above zero, indicating the predictive relevance of the structural model. The mediators, relational attitudes and teamworking quality contribute to f^2 effect size = 0.26, a medium to large effect size according Hair et al.'s (2013a, 2013b) guideline. It is supported that the structural model has a significant level of predictive validity on project performance.

4.2.1. The relative direct effects of contract types and incentive on relational attitudes and teamworking quality

The results in Fig. 2 and Table 1 show that the projects with partnering/alliance contract are associated with better relational attitudes than those with lump-sum ($a_{11} = 0.315$, $p < 0.05$) and reimbursable contracts ($a_{21} = 0.341$, $p < 0.05$). However, the projects with lump-sum contract do not have better relational attitudes than those with reimbursable contract (a_{21}–$a_{11} = -0.026$, $p = 0.827$). Adjusting for the differences in relational attitudes, the projects with partnering/alliance contract do not differ in teamworking quality from those with lump-sum ($a_{12} = 0.125$, $p = 0.193$) and reimbursable contract ($a_{22} = -0.019$, $p = 0.856$). The results suggest that only hypothesis 1a and 1b are supported. Hypotheses 2a and 2b are not supported.

The effects of contractual incentives on relational attitudes and teamworking quality seem to follow a similar pattern. The projects with contractual incentives are significantly associated with better relational attitudes compared to those without incentive ($a_{31} = 0.225$, $p < 0.05$) but not different in terms of teamworking quality ($a_{32} = -0.014$, $p = 0.856$). Hypothesis 3 is supported and hypothesis 4 is not supported.

4.2.2. The relative direct effects of contract types and contractual incentive on project performance

Although not explicitly hypothesized, we analyzed how different contract types and contractual incentives might have different direct effects on project performance controlling for relational attitudes and teamworking quality. The direct paths from two contract types and contractual incentive to project performance in Fig. 2 and Table 1 suggest that the performance of projects with partnering/alliance contract is not significantly different from those with lump-sum ($c'_1 = 0.062$, $p = 0.666$) or reimbursable contract ($c'_2 = 0.059$, $p = 0.708$). Similarly, the performance of projects with lump-sum contract is not different from those with reimbursable contract ($c'_2–c'_1 = 0.004$, $p = 0.973$). Also with regard to contractual incentive, the projects with incentive-based contract do not perform better than those without incentive ($c'_3 = -0.176$, $p = 0.109$).

4.2.3. The effects of relational attitudes and teamworking quality on project performance

Fig. 2 and Table 1 show that after controlling for contract types and contractual incentives, relational attitudes significantly increase teamworking quality ($d_{21} = 0.574$, $p < 0.001$). Teamworking quality, in turn, significantly increases project performance ($b_2 = 0.460$, $p < 0.01$). Independent of the effects on teamworking quality, however, relational attitudes do not affect project performance ($b_1 = 0.103$, $p = 0.408$).

Because our model involves a mediation mechanism with two mediators, the structural model should meet the *no-interaction assumption* or homogeneity of regression (Hayes and Preacher, 2014), i.e.: the effects of the mediators (relational attitudes and teamworking quality) on the dependent variable (project performance) should be invariant across the values of independent variables (contract types and contractual incentives). If the assumption is violated, any indirect effect does not accurately characterize the effects of relational attitudes and teamworking quality on project performance because these effects (b_1 and b_2) are dependent on contract types or contractual incentive. To test this assumption we included six interaction terms between independent variables and mediators into the regression model to estimate project performance (Eq. (3)). The difference in R^2 between two estimations of project performance with and without six interaction terms ($R^2 = 0.536$ and $R^2 = 0.524$ respectively) is $\Delta R^2 = 0.012$ and non-significant ($F(6,96) = 0.421$, $p = 0.863$). Thus, the homogeneity of regression assumption is maintained and any interaction effects can be ruled out. This also implies that the effects of teamworking quality and relational attitudes (through teamworking quality) on project performance are independent of contract type and contractual incentive.

4.2.4. The relative indirect effects of contract types and contractual incentive on project performance mediated by relational attitudes and teamworking quality

Hypotheses 5 and 6 assume that different contract types or contractual incentives might have different relative indirect effects on project performance through their effects on relational attitudes and teamworking quality. Using PROCESS tool, we estimated these relative indirect effects with 10,000 bootstrap subsamples as shown in Table 2. There are three specific pathways where contract types and contractual incentives may indirectly affect project performance: via $M_1 \rightarrow Y$ (relational attitudes then project performance), via $M_1 \rightarrow M_2 \rightarrow Y$ (relational attitudes then teamworking quality and finally to project performance), and via $M_2 \rightarrow Y$ (teamworking quality then project performance).

The results in Table 2 indicate that the projects with partnering/alliance contract significantly perform better than those with lump-sum contract through the pathway $D_1 \rightarrow M_1 \rightarrow M_2 \rightarrow Y$ or through better relational attitudes which in turn lead to better teamworking quality ($a_{11}d_{21}b_2 = 0.084$, $CI = 0.019$ to 0.222). Likewise, the projects with partnering/alliance contract significantly perform better than those with reimbursable contract due to the pathway $D_2 \rightarrow M_1 \rightarrow M_2 \rightarrow Y$ or through better relational attitudes which in turn lead to better teamworking quality ($a_{21}d_{21}b_2 = 0.091$, $CI = 0.017$ to 0.239). With regard to the difference between reimbursable and lump-sum contracts, only the specific pathway through teamworking quality, $(D_1–D_2) \rightarrow M_2 \rightarrow Y$ is significant ($(a_{12}–a_{22})b_2 = 0.067$, $CI = 0.003$ to 0.190).

Finally, the projects with incentive-based contracts significantly perform better than those without incentive ($a_{31}d_{21}b_2 = 0.060$, $CI = 0.010$ to 0.155) as the results of better relational attitudes which in turn lead to better teamworking quality ($X_2 \rightarrow M_1 \rightarrow M_2 \rightarrow Y$). To sum up, hypotheses 5a, 5b, and 6 are empirically substantiated.

5. Discussion

5.1. Contribution and theoretical implications

In this study we hypothesized that different contract types and contractual incentives can have different effects on project performance directly or indirectly through owner–contractor relationship quality (i.e.: relational attitudes and teamworking quality). Such a conceptual model was not considered in prior research. By analyzing the direct and indirect effects of contract types and contractual incentives on project performance, our study provides some important insights into the current literature on project contracting and collaboration.

The first important finding clarifies the effect of partnering/alliance contract compared to lump-sum and reimbursable contracts. The partnering/alliance contract, on average, is indirectly associated with better project performance compared to lump-sum or reimbursable contract through better relational attitudes and teamworking quality. This corroborates the findings of partnering and alliance studies reporting that the performance of partnering or alliance projects are strongly determined by commitment, trust, no blame culture, and openness shared by senior management representing owner and contractor; and effective teamworking (Chan et al., 2004, 2012; Green, 2003; Laan et al., 2011; Walker and Lloyd-Walker, 2015). Apart from its indirect effects through relational attitudes and teamworking quality, the direct effect of partnering/alliance contract on project performance does not differ from lump-sum and reimbursable contracts. Considering

both the indirect and direct effects as the total effect (see Table 2), partnering/alliance projects, although not statistically significant, are likely to perform better than those with lump-sum or reimbursable contract. This finding partly contradicts Merrow's (2011) conclusion that partnering/alliance projects tend to perform worse than those with lump-sum and reimbursable contracts. Unlike Merrow (2011), this study analyzes both indirect and direct effects of different contract types rather than on the total effect only.

The second important finding is regarding the influence of contractual incentives. There are two perspectives that appeared to be inconsistent regarding the effects of incentive-based contracts on project performance. The first perspective represented by Berends (2007) and Meng and Gallagher (2012), suggests that the use of an explicit incentive structure facilitates trust and open communication (better relational attitudes) between owner and contractor which in turn enhances the teams' performance in executing the project management processes (better teamworking quality) and finally leads to better project performance. The second perspective reflects Merrow's (2011) finding that the success rate of projects with incentives is actually lower than those without incentives, although not statistically significant. He concludes that the effect of incentives on project success simply occurred by chance. Our finding clarifies the above seemingly contradictory views. Firstly, incentive-based contracts are indirectly associated with better project performance relative to those without incentive through its positive effect on relational attitudes which in turn lead to enhanced teamworking quality. This indirect mechanism supports the first perspective (Berends, 2007; Meng and Gallagher, 2012). Apart from this indirect mechanism, we also found that incentive-based contracts, although not statistically significant, have negative direct effect on project performance. When we consider both the indirect and the direct effects of contractual incentives, they are canceling each other leading to non-significant total effect on project performance (see Table 2). This supports the first perspective (Merrow, 2011) that contractual incentives have no effect on project performance. In summary, both perspectives are actually not contradictory.

The third important finding relates to a common belief that the relationships in projects with lump-sum contract tend to be more adversarial than those with reimbursable contract (e.g., Smith, 2002). Although not explicitly hypothesized, we also compared the relative effect between the two contract types. The results do not provide empirical support for this notion. We found virtually no difference in the degree of relational attitudes and teamworking quality between reimbursable and lump-sum projects. This finding concurs Parker and Hartley's (1997) view that traditional contracting does not always result in adversarial attitudes. On the other hand, we found that through better teamworking quality, projects with reimbursable contract perform better than those with lump-sum contract. This is not a surprise since a reimbursable contract entails the larger owner's team to steer, coordinate, and support the contractor's team toward the achievement of the project objectives (Berends, 2007; Merrow, 2011).

Last but not least, after controlling for contract types and incentives, we found that relational attitudes significantly lead to enhanced teamworking quality which in turn improves project performance. This implies that apart from the effects of contract types and incentive, the quality of owner–contractor collaboration positively contributes to project performance. This finding also illuminates the notion "no contracting approach guarantees success; most contracting approaches can succeed" (Merrow, 2011, p.253). What matters more is the ability of both parties to develop relational attitudes and translate this into real teamworking (Suprapto et al., 2015).

5.2. Managerial implications

This study provides some important implications for senior management, business or contract managers, and project managers of firms who are seeking and developing appropriate contracting strategies for capital project execution.

The first implication is related to the effects of different contract types on project performance. Relative to lump-sum or reimbursable contract, partnering/alliance contract is positively associated with higher degree of relational attitudes and teamworking quality which in turn translates into better project performance. If there is freedom to select a contract type for a project, we advise senior management and/or project managers to use a partnering/alliance contract because it enhances relational attitudes leading to more effective teamworking and eventually better project performance. However, managers should be aware that such a contract does not directly increase project performance on its own but indirectly through its effect on relational attitudes and then teamworking quality. Partnering/alliance and contractual incentives do have a positive influence on the project but they also come at a cost. Managers from both sides need to ensure ongoing support from senior management and translate their shared norms into effective teamworking throughout the project life cycle (see also Chan et al., 2012; Laan et al., 2011; Walker and Lloyd-Walker, 2015). Failure to do so, the project performance might not change as with other contract types.

The third implication is related to the efficacy of relational attitudes and teamworking quality on project performance. We found that after controlling for contract types and incentives, the quality of owner–contractor relationship (relational attitudes at inter-organizational and teamworking at team levels) significantly influences project performance. Although the results suggest that partnering/alliance contract is relatively better, in many cultures, a lump-sum contract remains the most chosen contract type followed by reimbursable contract (this study and Merrow, 2011). If a lump-sum or reimbursable contract is already predetermined for a project, we advise managers from both sides to put extra attention on developing relational attitudes and ensuring effective teamworking. Also because relational attitudes do not directly improve project performance but through teamworking quality, project managers need: (a) to secure the ongoing parent organizational support by catalyzing a joint commitment and norms of trust and respect between senior management, and (b) to ensure

ongoing effectiveness of teamworking by fostering communication, coordination, cohesion, balanced contribution, mutual support, aligned effort, and affective trust.

Finally, managers need to be cautious when considering using incentive schemes. Our findings suggest that contractual incentives have significant positive indirect effect but also negative direct effect, although not statistically significant. The implication is clear, contractual incentives are no substitute for real collaborative relationship and should not be used to limit the owner's involvement in the process of collaboration (Berends, 2015; Meng and Gallagher, 2012). Contractual incentives cannot improve performance if the managers (senior management and project managers) from both sides do not share equitable commitment, respect and trust and properly manage to articulate a direction persuasively on the extent the teams work together, contribute solutions to problems, and confront difficulties whenever they arise at.

5.3. Limitations and future research

This study has some limitations in its results and conclusions. The first limitation is related to the research design employed in this study. This study was observational hence the correlational nature of data collection could not establish the temporal precedence. Our findings should not be interpreted as evidence of causality but rather as supporting a predictive scheme.

Other limitations are related to the characteristics of the data used in this study. The data was based on the respondents' subjectivity thus all constructs and their relations should be interpreted as the phenomenon as perceived by the practitioners. The representativeness of the sample may limit the generalizability of the findings. Although the sample includes practitioners' reflection on projects in various countries in different continents, the majority (64%) of them were based in the Netherlands. Some projects executed in countries like Asia, Middle East, South America, and North America regions can have different characteristics given different country-specific regulations and cultures. The same limitation also applies to the project type due to the strong presence of oil, gas, and petrochemical projects (60%) in the sample. Future studies should aim to replicate the findings with a larger sample, in different countries and project types. Another promising avenue for future study is to extend our research model by considering complexity and cultural factors as potential moderators.

Another limitation is concerning the partnering/alliance contract. This study did not distinguish partnering from 'pure' alliance contract. The proponents of 'pure' alliance argue that alliance is a legally enforceable form of relational contracting with formal charter, governance and management structures (see Ross, 2003; Walker and Hampson, 2003). Despite this limitation, we are confident that our finding remains supported for the relative advantages of alliance contract over lump-sum or reimbursable contract. Nonetheless, future studies with a larger sample could extent the analysis by further comparing the performance of alliance with partnering contract.

Finally, although our comprehensive model includes important constructs reflecting two types of relationships, relational attitudes at inter-firm level and teamworking quality at inter-team level, we were unable to include other types of relationships, for example, the relationship between the parent organization (senior management) and the corresponding team members that could potentially affect project performance. Future research should explore the effect of these other types of relationships.

6. Conclusions

Researchers and practitioners have acknowledged the importance of the more collaborative contracts to achieve better project performance by promoting a better working relationship between owner and contractor. However, mixed results of different contract types on project performance suggest the need for research on intermediate mechanisms linking the effects of contract types to project performance. This study applies a mediation model in which relational attitudes and teamworking quality mediate the effects of contract types and contractual incentives on project performance. The results support the notion that a partnering/alliance contract is likely to be more collaborative than a lump-sum or reimbursable contract. However, there is no evidence that a reimbursable contract is more collaborative than a lump-sum contract. Furthermore, it is supported that through better relational attitudes and teamworking quality, projects with a partnering/alliance contract are likely to perform better than those with lump-sum and reimbursable contracts. In the same way, projects with contractual incentives are likely to perform better than those without incentives through better relational attitudes and teamworking quality. The results also suggest the efficacy of relational attitudes and teamworking on project performance regardless of the contract types and the presence of incentives. All in all, contract types and contractual incentives per se are not the game changer but the parties' attitudes toward collaborative relationship and how they play out throughout the project into actual teamworking behavior.

Conflict of interest

There is no conflict of interest.

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Appendix 1. Measurement model specifications

Constructs/indicators	Loadings	AVE	CR	α
1. Project performance (formative construct)[a]		–	–	–
Weighted average of schedule, cost, quality, safety, and operability	0.804	Weight = 0.421, $p < 0.01$		
This project made a positive impact on the owner's business	0.593	Weight = 0.119, ns		
This project was a commercial success to the contractor	0.787	Weight = 0.389, $p < 0.01$		
Both owner and contractor were satisfied about the project outcomes	0.855	Weight = 0.334, ns		
2. Relational attitudes (2nd-order formative construct)				
2.1. Senior management commitment (1st-order reflective construct)		*0.732*	*0.891*	*0.817*
Senior management committed to provide necessary resources and support	0.843			
Senior management shown consistent and passionate leadership	0.896			
Senior management actively resolved potential conflicts when needed	0.826			
2.2. Relational norms (1st-order reflective construct)		*0.671*	*0.911*	*0.877*
The contractor was enthusiastic in achieving the owner's objectives	0.773			
The contractor felt confident that owner is reliable and trustworthy	0.843			
The owner believed the contractor made its best efforts	0.876			
Both parties adopted 'no blame culture' whenever problems arise	0.830			
Both parties intentionally being open and honest in any interactions	0.769			
3. Teamworking Quality (2nd-order formative construct)				
3.1. Communication (1st-order reflective construct)		*0.690*	*0.898*	*0.849*
Both teams communicated directly with each other	0.707			
Project-relevant information was shared openly by both teams	0.882			
Whenever a problem is detected, it was immediately communicated	0.870			
Both teams were satisfied with the usefulness of the information shared	0.850			
3.2. Coordination (1st-order reflective construct)		*0.689*	*0.898*	*0.848*
The work done on tasks within the project was synchronized	0.810			
There were comprehended goals for tasks between the teams	0.872			
The goals for tasks were accepted by both teams	0.863			
There was no conflict between the teams regarding tasks and goals	0.771			
3.3. Cohesion (1st-order reflective construct)		*0.631*	*0.872*	*0.805*
Core team-members were personally engaged to this project	0.819			
Core team-members were integrated as one team	0.731			
Core team-members felt proud to be part of the teams	0.844			
Core team-members felt responsible for maintaining relationships	0.779			
3.4. Balanced contribution (1st-order reflective construct)		*0.716*	*0.883*	*0.802*
Both teams recognized each other's specific strengths/weaknesses	0.816			
Both teams contributed in accordance with their specific potential	0.857			
There were balanced contributions that prevented conflicts	0.865			
3.5. Mutual support (1st-order reflective construct)		*0.694*	*0.872*	*0.779*
Both teams supported each other as best as they could	0.872			
Whenever problems occurred, they were resolved constructively	0.850			
Every critical decision was made jointly by both teams	0.774			
3.6. Aligned effort (1st-order reflective construct)		*0.738*	*0.894*	*0.823*
Every team made this project their highest priority	0.872			
Both teams put their best effort into this project	0.883			
There was no conflict regarding the effort that one team put into	0.822			
3.7. Affective trust (1st-order reflective construct)		*0.635*	*0.913*	*0.885*
Both teams were comfortable being dependent on each other	0.736			
Both teams had kept their promises	0.778			
Both teams had high levels of integrity	0.829			
Both teams had been fair to each other	0.855			
Both teams had looked out for each other companies' interests	0.797			
Both teams could rely on each other to not taking advantage	0.781			
4. Front-end definition (reflective construct)		*0.624*	*0.869*	*0.802*
Clarity of the project goals and objectives	0.796			
Clarity of the project scope	0.781			
Quality of the project basic engineering design	0.754			
Quality of the project execution plan	0.827			
5. Project size (reflective construct)		*0.767*	*0.868*	*0.708*
Total installed cost	0.926			
Project duration	0.823			
6. Firm size (reflective construct)		*0.898*	*0.946*	*0.890*
Number of employees	0.965			
Annual revenues	0.930			

Note: AVE = average variance extracted; CR = composite reliability; α = Cronbach's alpha; all loadings are significant at $p < 0.001$; ns = not significant.

[a] Formative construct, each indicator is retained if the weight is significant or the loading above the threshold 0.5.

Appendix 2. Constructs intercorrelations and discriminant validity

Latent construct		Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Senior management commitment	1	3.74	0.77	**0.86**																			
Relational norms	2	3.67	0.75	*0.55*	**0.82**																		
Relational attitudes (M_1) [a]	3	3.70	0.67	*0.78*	*0.95*	**N/A**																	
Communication	4	3.83	0.70	*0.45*	*0.58*	*0.61*	**0.83**																
Coordination	5	3.64	0.76	*0.47*	*0.56*	*0.59*	*0.68*	**0.83**															
Cohesion	6	3.62	0.69	*0.49*	*0.64*	*0.66*	*0.61*	*0.62*	**0.80**														
Balanced contribution	7	3.53	0.65	*0.48*	*0.60*	*0.63*	*0.63*	*0.65*	*0.66*	**0.85**													
Aligned effort	8	3.61	0.74	*0.51*	*0.50*	*0.57*	*0.50*	*0.55*	*0.60*	*0.54*	**0.86**												
Mutual support	9	3.70	0.74	*0.44*	*0.63*	*0.63*	*0.63*	*0.65*	*0.61*	*0.66*	*0.67*	**0.83**											
Affective trust	10	3.52	0.68	*0.49*	*0.73*	*0.73*	*0.63*	*0.65*	*0.73*	*0.71*	*0.63*	*0.76*	**0.80**										
Teamworking quality (M_2) [a]	11	3.62	0.59	*0.57*	*0.74*	*0.76*	*0.81*	*0.83*	*0.83*	*0.82*	*0.75*	*0.85*	*0.90*	**N/A**									
Front-end definition	12	3.55	0.75	*0.47*	*0.46*	*0.52*	*0.44*	*0.48*	*0.37*	*0.44*	*0.31*	*0.44*	*0.50*	*0.52*	**0.79**								
Project size	13	4.09	1.62	*0.18*	*−0.04*	*0.04*	*0.02*	*0.02*	*0.12*	*0.02*	*0.20*	*−0.08*	*−0.10*	*0.01*	*−0.06*	**0.88**							
Firm size	14	3.62	1.40	*0.12*	*0.09*	*0.11*	*0.23*	*0.19*	*0.17*	*0.18*	*0.12*	*0.19*	*0.20*	*0.22*	*0.02*	*0.30*	**0.95**						
Prior relationship duration [c]	15	8.76	9.97	*0.04*	*0.17*	*0.14*	*0.14*	*0.17*	*0.09*	*0.14*	*0.10*	*0.12*	*0.19*	*0.17*	*0.12*	*0.02*	*0.02*	**N/A**					
Early contractor involvement [c]	16	0.66	0.48	*0.19*	*0.31*	*0.30*	*0.22*	*0.27*	*0.39*	*0.31*	*0.39*	*0.28*	*0.36*	*0.38*	*0.25*	*0.11*	*0.16*	*0.15*	**N/A**				
PAL vs. RE (D_1) [c]	17	0.34	0.48	*0.00*	*0.07*	*0.05*	*0.12*	*0.17*	*0.12*	*0.09*	*0.05*	*0.19*	*0.15*	*0.16*	*−0.08*	*−0.08*	*0.06*	*0.18*	*0.17*	**N/A**			
PAL vs. LS (D_2) [c]	18	0.54	0.50	*0.06*	*0.10*	*0.09*	*0.01*	*−0.02*	*0.03*	*0.04*	*−0.02*	*−0.04*	*−0.04*	*−0.01*	*0.16*	*−0.07*	*−0.01*	*−0.19*	*−0.07*	*−0.77*	**N/A**		
Contractual incentive (X_2) [c]	19	0.37	0.49	*0.24*	*0.19*	*0.23*	*0.15*	*0.18*	*0.22*	*0.08*	*0.22*	*0.10*	*0.16*	*0.19*	*0.09*	*0.13*	*0.13*	*0.14*	*0.20*	*0.17*	*−0.15*	**N/A**	
Project performance (Y) [b]	20	3.40	0.73	*0.29*	*0.54*	*0.51*	*0.52*	*0.51*	*0.45*	*0.40*	*0.42*	*0.55*	*0.56*	*0.60*	*0.62*	*−0.08*	*0.13*	*0.03*	*0.16*	*0.02*	*0.10*	*−0.01*	**N/A**

Note: $N = 113$; values below diagonal (in italics) are correlations; values on diagonal (in bold) are the square root of average variance extracted (AVE); PAL = partnering/alliance contract; RE = reimbursable contract; LS = lump-sum contract.

[a] Not applicable (N/A) for higher-order formative construct.

[b] Not applicable (N/A) for formative construct.

[c] Not applicable (N/A) for single item construct.

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