How Contractor Behavior Affects Engineering Project Value-Added Performance

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How Contractor Behavior Affects Engineering Project Value-Added Performance

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Abstract: Contractors are one of the most important project participants, and their behavior has gained increasing attention for improving performance, but few studies have been devoted to focusing on the forms of contractor behavior and project value-added performance. This study developed and tested a theoretical model to investigate how different types of contractor behavior (perfunctory, consummate, and opportunistic) affect engineering projects value added (EPVA) and analyze the moderating role of contract complexity and task complexity. The multiple regression analysis approach is used to analyze data collected from a questionnaire-survey of 290 Chinese project professionals. The results show that three types of contractor behavior have a significant impact on EPVA, i.e., contractor perfunctory and consummate behaviors have a significant positive impact, while opportunistic behavior has a significant negative impact. Additionally,

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contractor consummate behavior was found to have the strongest impact, followed by perfunctory and opportunistic behavior. The moderation results showed that the positive impact between perfunctory behavior and EPVA is strengthened and weakened by contract and task complexity respectively, while the negative impact of opportunistic behavior is weakened and strengthened respectively. The contract and task complexity have no significant moderating impact on the relationship between contractor consummate behavior and EPVA. The findings of this study contribute to the project governance and project performance literature and provide new knowledge for academe and practice for a deeper understanding of how to realize EPVA from the perspective of contractor behavior.

Keywords: Engineering projects; Contractor behavior; Value added; Contract complexity; Task complexity.

Introduction

As high-tech achievements continue to penetrate the construction industry, the construction market is undergoing profound changes. Owners expect not only the basic goals of the contract to be realized, but also that project performance will be improved and even engineering project value added (EPVA) (Saito et al., 2012). As a result, construction management is becoming more systematized, specialized, and informational, with a clear trend towards integrated contract delivery (Ilozor and Kelly, 2012). However, owners can provide only the expected objectives, functional requirements, and design standards of their projects and are unable provide detailed design drawings when tendering (Wang and Zhang, 2014). Therefore, contractors need to analyze the owner's project demands before construction, with the traditional principle of "drawings-based construction" being transformed into "contract-based construction".

Prior studies have investigated the appropriate governance mechanism - based on contract - that improves project performance, such as project management technology, risk allocation and trust (Mir and Pinnington, 2014; Du et al., 2014; Cheung et al., 2013), because these factors contribute to promoting cooperative behavior (Wu et al., 2017a), reduce *ex post* transaction costs (Connelly et al., 2015), and increase relationship value (Chen et al., 2017). Contract reference point theory (Hart and Moore, 2008), on the other hand, shows that the contract can be taken as a reference point influencing the contracting parties' behavior; the need to modify and adjust the contract during execution (because of the incompleteness of the initial contract) triggering cognitive and affective responses from the contracting parties (Bartling and Schmidt, 2015). Therefore, increased attention is being paid to individual behavioral responses to the mechanism design used and the importance of participants' behavior in improving project performance (Zhang et al., 2016; Hsu et al., 2017). This is particularly the case with the contractor, as the most important participant in the overall process of a construction project, whose behaviors are closely related to project performance (Alzahrani and Emsley, 2013).

Although previous studies indicate that contractor behavior has a considerable impact on project performance, these studies have concentrated on only such basic project performance measures as cost, duration, and the quality stipulated in the contract (Meng, 2012; Hsu et al., 2017). They have made little attempt to consider the project's function and even EPVA, and therefore this study extends research by exploring the EPVA. Moreover, previous studies exploring contractor behavior mainly regard it as opportunistic and cooperative (Ren et al., 2007; Lui et al., 2009). This study is based on Yan et al. (2018) and classifies contractor behavior into perfunctory, consummate, and opportunistic behavior. In addition, some controversial findings been reached under different contexts. For instance, while Laan et al. (2011) show that opportunistic contractor behavior has a significant negative impact on project performance, Lu et al. (2015) indicate that contractors' opportunistic behavior has no direct impact on project performance - the difference being mainly attributed to contextual factors (Baron and Kenny, 1986). These limitations mean there is a lack of theoretical basis for improving project performance through contractor behavior. In particular, the impact of the specific mechanisms involved and the contractor behavior path to realize EPVA are in need of further clarification.

To bridge this gap, this paper aims to explore the effect of different contractor behaviors on project value-added performance, in consideration of the moderating effect of contextual factors. The following sections develop the research model and hypotheses, analyze the results, and discuss the mechanisms behind different contractor behaviors and EPVA. The findings of this study enrich the knowledge of project governance and project performance and provide new knowledge for academe and practice for a deeper understanding of how to realize EPVA from the perspective of contractor behavior.

Literature Review and Theoretical Model Construction

Engineering Project Value Added

Since the introduction of EPVA (e.g., Presutti, 2003), the concept of value added performance of engineering projects has evolved into a new performance goal that has attracted the attention of several studies. According to Shi (2011), the function of project EPVA is to enhance the project process by establishing the correct project management mode. Specifically, the goal of EPVA is to execute the project as quickly as possible while simultaneously guaranteeing its quality; it mainly includes saving production or transaction costs (Yue and Ren, 2016), shortening the project life cycle, and eliminating non-value-adding activities (Gracanin et al., 2014). With the continuous advancement of sustainable development, sustainable value creation is also an important goal of EPVA (Badurdeen et al., 2015). Fernandes (2012) proposed the adoption of new technology, new methods, etc., to reduce construction and operation costs can be a project EPVA process. Moreover, others believed that EPVA not only embodies project entities, but also involves communication, information sharing, establishment of trust, improvement of core competence, and the possibility of future cooperation among participants (Chen, 2012; Wu et al., 2017).

Actually, EPVA is based on project stakeholders' demands and the goals they want to achieve, and this needs to be considered and balanced. However, engineering projects have many stakeholders, including owners, contractors, design units, and supervision units involved throughout the whole period of construction, with heterogeneous demands involving multidimensional individual differences (Wang et al., 2015). When demand is inconsistent, for instance, a core value analysis should be carried out before the value-adding analysis (Luo, 2015). This involves correctly determining the project's core value from design to production based on the customer's viewpoint and achieving the maximum satisfaction of customer's demands

(Terpstra and Verbeeten, 2014). As the owner has the right to use the project and is service object of the contractor, the core value of an engineering project is the result of the consultation and compromise between stakeholders based on the owner’s demands. This may be either explicit, as clearly agreed in the contract, or implicit, as expected goals not clearly agreed in the contract (Liu, 2013). Moreover, projects involve the short-term project performance goal of achieving current delivery, and longer-term goals that also consider future benefits (Al-Tmeemy et al., 2011).

Based on the foregoing review, therefore, we define EPVA as combining the owner's demand and time dimension, with the short-term goal of improving the owner’s explicit demands clearly agreed in the current delivery contract, and the longer-term goal of realizing the owner’s implicit demands that are not clearly agreed but nevertheless expected for future operations. The short-term goal is to minimize costs, shorten duration, and improve functional structure as far as possible. While the long-term goal is to have good communications and less disputes between the owner and contractor, the adoption of new technology, new methods and other innovations, reducing the negative impact on the environment, reducing the costs of operation and maintenance, enhancing mutual trust, and obtaining future cooperation opportunities, etc.

Theoretical Model Construction

Project organizations are established for a specific task, and the organization’s objectives and tasks are embedded in their operating environment and structural arrangement (Lu et al., 2015). Complexity is an objective task characteristic that increases the cost of transactions, because of the increase in uncertainty, and difficulty in the decomposition and allocation of tasks (Higgs, 2013).

Moreover, due to the many stakeholders involved in engineering construction projects, task complexity increases coordination difficulties, the frequency of transactions, and corresponding management and bargaining costs.

A contract provides a lawful and institutional framework for the owner and contractor's rights, duties, and responsibilities, and it offers guidance and a basis for both parties to cooperate, manage conflicts, and adapt to contingent events (Poppo and Zenger, 2002). It also helps to deal with problems caused by uncertainty and task complexity. However, contracts may be incomplete and costly to draft. Owners and contractors still attempt to make contracts more complex to protect their rights (Shi et al., 2018). Because high term specificity helps each party to understand its responsibility better, while also providing sufficient evidence for third parties to make a fair judgment more easily (Lu et al., 2016). However, if they are too detailed and strict, contractual terms and conditions can make the contract parties distrust each other, which affects their desire for cooperation (Geyskens, 2005). Therefore, the detailed contract level, sometimes termed "contract complexity" (Wang, 2018), also affects transaction risks.

Therefore, reaching engineering project goals is largely related to the contextual factors surrounding project contract and task complexity. Accordingly, a theoretical model between contractor behavior and project value-adding performance is proposed as shown in Figure 1. The terms of perfunctory, consummate, and opportunistic behavior are elaborated in the following section concerning the adopted research hypotheses.

Research Hypothesis

Contractor Behavior and EPVA

(1) Contractor perfunctory behavior and EPVA

Contractor perfunctory behavior refers to the contractor taking verifiable and remunerative actions as specified in the contract, including the three dimensions of proper implementation, full completion, and matching expectations (Yan et al., 2018).

As a formal mechanism, the contract wording can reduce uncertainty and transaction risk, and promote the realization of transactions (Schepker et al., 2014). Studies have shown that setting goals can convert people's demands into a motivation to satisfy those demands; because the goal itself has an incentive effect that can encourage goal-seeking behavior. At the same time, comparing their own action outcomes with a set of expected goals and making timely self-adjustments and improvement can also effectively help achieve the goals (Drury-Grogan, 2015). As Deshon and Alexander's (1996) discussion concerning setting contract goals from explicit tasks and tacit knowledge suggests, when a task is explicit, setting contract goals will lead to a steady increase in performance.

In practice, the content of many contracts reflects such EPVA goals as "optimizing the design plan as far as possible to meet the process requirements, reducing the investment, and ensuring safety, quality, and duration in the construction" (Dehghan et al., 2015). The contractor must therefore take the contract terms seriously, comply with the obligations stipulated in the contract, and realize the agreed performance objectives to avoid being penalized for breach of contract

(Haidar,2011), while maintaining its good reputation and long-term cooperation and development(Beuve and Desrieux, 2013). Therefore, the first hypothesis is proposed as

Hypothesis 1. **The contractor perfunctory behavior has a positive impact on project value added performance.**

(2) Contractor consummate behavior and EPVA

Contractor consummate behavior refers to the contractor providing voluntary initiative and altruistic actions in the spirit of mutual trust and cooperation to achieve the goal of EPVA to the maximum extent. This comprises four dimensions of voluntary altruism, automatic risk control, mutual collaboration, and making-up contract loopholes (Yan et al., 2018).

As Cretu et al. (2014) asserts, engineering project risk management is concerned with minimizing risk and maximizing opportunities in project decision-making through active stakeholder cooperation; the purpose is not to avoid risk, but ensure that project goals are reached or even exceeded by more reliable decision making. Similarly, Teller et al. (2014) believe that contractors use their own risk management capabilities and technologies to internalize project risks avoiding backflow to owners, providing an important guarantee for impeccable project performance. In addition, some studies observe that the altruistic preferences of contractors can not only improve project performance, but also improve their effectiveness (Pu et al, 2016). For example, rationalization advice provided by contractors concerning the improvement of design proposals and the use of other materials, can reduce project investment costs, shorten the construction period, and improve the project's economic benefits (An et al., 2017). Altruistic behaviors also provide their own benefits and influence, such as in creating opportunities for cooperation (Han et al, 2013). In addition, the contractor's actions to make-up contract loopholes and mutual collaboration means that they actively help and coordinate project stakeholders on the construction site, promote the flow of information during project implementation, and enhance mutual trust (Barney and Hansen, 1994; Wei and Yang, 2008). These arguments are summarized in the second hypothesis:

Hypothesis 2. **The contractor consummate behavior has a positive impact on project value added performance.**

(3) Contractor opportunistic behavior and EPVA

Contractor opportunistic behavior refers to the contractor taking advantage of its own information superiority, failing to fulfill its obligations, exploiting contract loopholes to generate profits, and other speculative behaviors, including the four dimensions of hiding information, reneging on commitments, avoiding informal agreements, and utilizing contract loopholes (Yan et al., 2018).

Many empirical studies have found that opportunistic behavior can increase agency costs and produce a series of negative effects on transactions, such as the termination of cooperative relationships, and reducing owner satisfaction and trust (Jap and Anderson, 2003; Villena et al., 2011; Wang and Yang, 2013). Luo (2000) believes that, if one party to the transaction seeks only its own interests and displays such opportunistic behaviors as breach of contract, rejection of tasks, and distortion of information, the other party will stop contributing valuable resources and exchanging information, and increase its vigilance to prevent the re-use of the relationship. In practice, according to Madden's research (2015), groups with different targets adopt such protective measures as concealing or delaying the transmission of unfavorable information, accelerating the reduction of timeliness, accuracy, and credibility of the two parties' communication, and when one party takes protective measures to interact, its partners also use the same strategy to protect their goals. Furthermore, there are studies pointing out that avoidance and apathetic communication are important reasons for tension in emergency cooperation (Kim, 2013). In addition, with regard to contract loopholes, contractors can carry out unbalanced bidding by using loopholes in the bidding documents (Yin, 2014), changing the contract's initial state to a demand for a change/claim, etc., resulting in delays and cost overruns, which seriously hinders project management performance. Thus, it is inferred that:

Hypothesis 3. **The contractor opportunistic behavior has a negative impact on project value added performance.**

The moderating effect of task complexity

Tasks generate transaction costs due to their complexity, which in turn affect project performance and final project success (Higgs et al., 2013). Simple tasks with a greater regularity and structure can be managed by standardized operation procedures. In contrast, complex tasks are often difficult to define clearly, increasing the necessity for team members to have an innovative way of thinking and working together to complete the task (Chae et al., 2015; Friedrich et al., 2016).

Complex tasks in engineering contracts are often difficult to define clearly, that is, the owner's explicit demand goals are vague for complex tasks. Therefore, in terms of perfunctory behavior, the contractor is unclear of the specific content of complex tasks, so it is not easy to achieve project performance goals. For the contractor consummate behavior, when facing complex tasks, an extra effort and cooperation with the team by the contractor will make the owner's vague or implicit demands more explicit and clearer of the specific content involved. While the contractor opportunistic behavior relies on different forms to seek loopholes or opportunities for profit making, so there are more opportunistic forms to choose from when facing complex tasks, i.e., more loopholes or opportunities available for profit making. Therefore, the following hypotheses concerning the moderating effect of task complexity are proposed.

Hypothesis 4. **The higher the task complexity, the weaker positive effect of contractor perfunctory behavior on project value-added performance goals.**

Hypothesis 5. **The higher the task complexity, the stronger positive effect of contractor consummate behavior on project value-added performance goals.**

Hypothesis 6. **The higher the task complexity, the stronger negative effect of contractor opportunistic behavior on project value-added performance goals.**

The moderating effect of contract complexity

Some studies show that contract complexity is a situation variable, the contract guides the actions of the related parties to achieve order by setting the detailed terms and therefore promoting appropriate behaviors (Marjolein et al, 2010). Some believe that specifying more relevant terms and clauses and accounting for more unanticipated contingencies in a contract can improve cooperative behavior between the transacting parties (e.g., Poppo and Zenger, 2002), referred to as contract complexity. Others further stress that specific contract terms can minimize the uncertainty of projects, compress speculation space, and effectively inhibit opportunistic behavior or 'rip-off' to improve transaction satisfaction (Yang and Shuai,2012; Langer et al.,2014;Lu et al.,2016). However, attempting to cover every aspect can easily lead to conflicts between the parties by making the relationships too rigid and restricting cooperation – leading to a real or perceived lack of trust (Lumineau, 2014). Non-contractual means are therefore needed to increase mutual trust and reduce subsequent disputes (Geyskens, 2005).

In terms of the contractor perfunctory behavior, therefore, providing detailed contract provisions makes it easier for the contractor to understand the scope of work and the owner's demands, and so easier to achieve the project goals. For the contractor consummate behavior, detailed contract provisions are often limiting; for example, owners sometimes interfere with the management of the construction when they are dissatisfied with its level, but their unfamiliarity with construction sites can mean that such action is not conducive to a smooth running project. Therefore, the contractor consummate behavior with complex contracts is not conducive to good project performance. The contractor opportunistic behavior mainly relies on different forms to seek loopholes or opportunities for profit making; when facing a complex contract, therefore, there are less opportunistic forms from which to choose and less loopholes or opportunities available for enhancing profit, making opportunistic behavior at this time have a weaker impact on project performance goals. Therefore, the following hypotheses concerning the moderating effect of contract complexity are:

Hypothesis 7. **The higher the contract complexity, the stronger positive effect of contractor perfunctory behavior on project value-added performance goals.**

Hypothesis 8. **The higher the contract complexity, the weaker positive effect of contractor consummate behavior on project value-added performance goals.**

Hypothesis 9. **The higher the contract complexity, the weaker negative effect of contractor opportunistic behavior on project value-added performance goals.**

Research Methodology

Questionnaire design and data collection

The stated hypotheses were empirically tested by a questionnaire survey of Chinese project professionals. As variables include EPVA, CPB, CCB, COB, CC and TC, which are complex and are difficult to record in project construction, it is very difficult to obtain information about them. Given that the project was completed by the professionals, they are very familiar with the project's situation. Therefore, the professionals were selected to evaluate the project situation based on their perceptions (Ozorhon et al., 2008). Due to the sensitive contractor behavioral decision factors involved, the target respondents covered a wide range of people closely related to the execution and management of engineering construction projects, including contractors, owners, supervision units and consulting units. The questionnaire was distributed both directly on site and by e-mail.

The questionnaire items all involved adapting and integrating existing measurement instruments, and were validated by an in-depth group interview with 18 well-known experts from a similar research field during which some items were improved according to their advice. Before undertaking the formal large-scale investigation, 100 preliminary questionnaires were distributed to owners, contractors, and third parties of engineering construction projects. 76 completed and valid questionnaires were returned and a preliminary data analysis was conducted to check their reliability. The questionnaire was revised again based on these responses and suggestions. In order to ensure that the respondents have an accurate understanding of the variables, the definitions are provided explicitly in the questionnaire. The respondents were asked to evaluate their degree of agreement with the items on a five-point Likert scale from 1 (strongly disagree) to 5 (strongly agree), according to their experiences of a recently finished project in which they were involved in the whole process and are most familiar with the situation involved, instead of just the overall experience of the respondents of multiple projects.

The questionnaire used is provided in Appendix S2.

In total, 500questionnaires were distributed and 360 were returned completed, a response rate of 72%. After deleting records with missing or unmatched data, 290 valid records remained, representing an effective response rate of approximately 58%. The descriptive statistics are shown in Table 1.

Table 1 shows that the 290 respondents comprise 32.41% employers, 44.48% contractors, and 23.10% others. 12.41% are project managers, 38.62% are department managers, 40.69% are project engineers, and 8.28% are others. The sample size was deemed adequate, as it provides the recommendations of a wide range of people closely related to the execution and management of engineering construction projects. In addition, the respondents have a good educational background and working experience, with 45.86% having over 10 years and 30% of 5 to 10 years of experience, and 7.24%, 53.79%, and 38.97% from specialist and below, undergraduate, and graduate and above qualifications, respectively.

Measurement

Contractor's perfunctory behavior: Following the definition of Yan et al. (2018), the contractors' perfunctory behavior is regarded as being closer to the concept of role behavior. Williams and Anderson's (1991) seven items for measuring role behavior have been widely used, whose core content includes 'completing the duties of the post', 'that the completed work meets performance requirements', etc. Anvuur and Kumaraswamy (2011) propose a basically consistent system for measuring contractor role behavior that covers 'fulfilling the responsibilities stipulated in their own work', 'achieving the expected performance of their own work role', and 'fully fulfilling the required work tasks'. Based on these studies, the measurements of contractor perfunctory behavior were developed and modified to suit the context of projects. Four items were derived for this measure, including 'The contractor can carry out the construction according to the construction drawings and standard specifications provided by the employer'.

Contractor's consummate behavior: The definition of contractor consummate behavior is closer to the concept of extra role behavior and organizational citizenship behavior. Anvuur and Kumaraswamy (2011) point out that contractor extra role behavior can be measured from the following aspects: ‘volunteering to do additional work beyond contractual agreements that can improve the project’, ‘offering reasonable advice to the owner, and ‘helping participants who need to adapt to the new work environment’. Lim and Loosemore (2017) divide contractor organizational citizenship behavior into four dimensions of commitment, social participation, cheapness, and respect for others. The measurements of contractor consummate behavior in this study were developed based on these studies in the same way as those for perfunctory behavior. Five items were derived, for example: ‘The contractor will take the initiative to put forward reasonable proposals for the employer (such as a cost saving plan)’.

Contractor's opportunistic behavior: The items used in the current research for measuring contractor opportunistic behavior are basically the same. The main contents include ‘the contractor conceals information’, ‘arbitrarily promises’, ‘breaches of contracts or agreements’, and ‘uses of contractual loopholes for profit’ (Yan et al., 2018; Lu et al., 2015). Contractor opportunistic behavior in this study is measured by four items, for example, ‘The contractor sometimes hides certain information for its own interests’.

EPVA: In the literature review section, the research systematically combed the construct of EPVA and pointed out the specific embodiment. Based on this review, nine items were identified for measuring EPVA from Camp and Sexton (1992), Shi (2011), Yue and Ren (2016), Gracanin et al. (2014), Chen (2012), and Dietrich et al. (2010). Two sample items are ‘The actual investment is less than the planned investment under the premise of achieving the established functions of the project’ and ‘After the end of the transaction, the credibility of the contracting parties has been improved and market competitiveness has been gained’.

Task complexity: In terms of the measurement of task complexity, Campbell (1988) adopts four items of ‘multiple possibilities for paths leading to results’, ‘multiple possible outcomes’, ‘contradictory and interdependent relationships between paths’ and ‘unsure relationships between paths and result’. Based on this research, Chae et al. (2015) believe that complex tasks also need team members to have full expertise, and experience of thinking and working to complete the task. Based on these studies, the measurements of task complexity were developed and modified to suit the project context. Five items were derived for this measure, of which one simple item is ‘The task involves many changes or factors that cannot be determined by both sides’.

Contract complexity: For the measurement of contract complexity, Ryall and Sampson (2009) start from the content stipulated in the contract and consider that most engineering contracts include (1) the specific rights and obligations of the project participants, (2) how to supervise and control the actions of the parties, and (3) specific punishment measures and incentive policies. In addition, Lumineau and Quelin (2012) believe that the contract content also includes terms for the adjustment of the price, dispute settlement, and termination of the contract. Drawing on these prior studies, five items were developed and modified for measuring contract complexity; for example, ‘The contract stipulates the terms for the dispute settlement and termination of the contract’.

All the survey items used are provided in Appendix S1.

Data Analysis and Hypothesis Testing

Reliability and validity analysis

Cronbach's alpha of all the constructs was examined to assess the internal consistency and reliability of the scales. A Cronbach's alpha greater than 0.7 denotes the reliability of the test items is relatively high. A confirmatory factor analysis (CFA) was also carried out. The criteria for determining its feasibility are mainly the KMO value (greater than 0.7) and Bartlett spherical test (p<0.05). The factor loading of each measurement index in the confirmatory factor analysis needs to be more than 0.6, and meet all fitting indicators（χ^2/df＜2，RMSEA＜0.08，NNFI＞0.90，IFI＞0.90, and CFI＞0.90). For convergent validity, construct reliability (CR>0.6) and average variance extracted (AVE>0.5) are used.

The results are shown in Table 2, which indicates that the measurement models of each variable have good reliability and validity, and the overall model is acceptable.

Table 2 shows that Cronbach's alpha for all the variables ranges from 0.831 to 0.909 which, being greater than 0.7, indicates their reliability is relatively high. The KMO indices are 0.779, 0.850, 0.824, 0.900, 0.780 and 0.838 (≥0.7), and Bartlett spherical test is significant, indicating that these data are suitable for confirmatory factor analysis. Furthermore, the confirmatory factor analysis is qualified as it meets all fitting indicators. In terms of construct reliability (CR) and average variance extracted (AVE), they range from 0.882 to 0.925 (>0.6) and 0.583 to 0.753 (>0.5), respectively, indicating that all the measures have good convergent validity. Thus, the measurement models of each variable have good reliability and validity, and the overall model is acceptable.

Table 3 presents the means, standard deviations and correlation coefficients of all the variables, and all pass the normality check.

Table 3 shows that there is a positive relationship between contractor perfunctory behavior, contractor consummate behavior, and EPVA (CPB: r=0.327, p<0.001; COB: r=0.540, p<0.001), and the existence of a negative relationship between contractor opportunistic behavior (r=-0.219, p<0.05), which supports H1, H2, and H3. In addition, contract complexity and task complexity are significantly related to EPVA at the 0.001 significance level. This result provides a necessary premise for the subsequent moderating effect test.

Hierarchical regression analyses

A hierarchical regression analysis was conducted to test and verify whether contract complexity and task complexity can further affect the direction and strength of the relationship between the three types of contractor behavior and EPVA. Hierarchical regression analysis is often used to evaluate the relationship between a set of independent variables and the dependent variable, taking into account the impact of a different set of independent variables on the dependent variable. This involves control variables, independent variables, and moderating variables in the research model. The change of R^2 (R^2-adjusted, ΔR^2) and F (F-adjusted, ΔF) is used to assess model fitness when adding new variables. First, the effect of the control variables is evaluated, and then the effect of different contractor behaviors on project EPVA to test H1, H2, and H3 is evaluated. Next, the moderating effect of task complexity is evaluated to test H4, H5, and H6. Finally, the moderating effect of contract complexity is evaluated to test H7, H8, and H9.

Before hierarchical regression analyses, in order to avoid multicollinearity interference, all the independent and moderator variables are standardized. Moreover, the Variance Inflation Factor (VIF) values of the variables in each model are all less the 10, indicating that there are no serious multicollinearity problems between variables. The hierarchical regression analysis results are shown in Table 4.

(1) Effects of control variables

According to previous research, the basic information relating to respondents comprise project role, position, education, and working years as control variables. The regression coefficients of the four control variables on project value-adding performance are not significant in Table 4 model 1, as are the regression coefficients of project role, position, education, and working years of respondents on EPVA, which indicates that differences between the EPVA are not related to project role, position, education, or working years of respondents.

(2) Main effects

Table 4 Models 2-4 introduce the main effects of the three types of contractor behavior on EPVA. In model 2, the regression coefficient of perfunctory behavior on EPVA is 0.327 and is significant ($p<0.001$), again verifying hypothesis H1; in model 3, the regression coefficient of consummate behavior on EPVA is 0.540 and significant ($p<0.001$), verifying hypothesis H2; while in model 4, the regression coefficient of opportunistic behavior on EPVA is -0.219 and significant

($p<0.05$), verifying hypothesis H3.Thus, the three types of contractor behavior have a significant impact on EPVA, and the main effects are significant.

(3) Moderating effects

Table 4 Models 5 and 6 investigate the moderating effects of contract complexity and task complexity on the relationship between contractor perfunctory behavior and EPVA. The regression coefficient of "perfunctory behavior x contract complexity" on EPVA is 0.266 and is significant ($p<0.001$) and the regression coefficient of "perfunctory behavior x task complexity" on EPVA is 0.168 and is significant ($p<0.001$). This indicates that both contract complexity and task complexity have a significant positive moderating effect on the relationship between perfunctory behavior and EPVA, and that hypotheses H4 and H7 are verified.

Similarly, Table 4 Models 7 and 8 investigate the moderating effect of contract complexity and task complexity on the relationship between consummate behavior and EPVA. The regression coefficient of "consummate behavior x contract complexity" on EPVA is 0.065 but is not significant ($p>0.05$). The regression coefficient of "consummate behavior x task complexity" on EPVA is 0.079 but is not significant ($p>0.05$). This indicates that contract complexity and task complexity have no significant moderating effect on the relationship between consummate behavior and EPVA, and that hypotheses H5 and H8 are not supported.

Finally, models 9 and 10 investigate the moderating effect of contract complexity and task complexity on the relationship between opportunistic behavior and EPVA. The regression coefficient of "opportunistic behavior x contract complexity" on EPVA is -0.175 and is significant

(p<0.05). The regression coefficient of “opportunistic behavior x task complexity” on EPVA is 0.188 and is significant (p<0.05). This indicates that contract complexity and task complexity have a significant negative moderating effect on the relationship between opportunistic behavior and EPVA, and that hypotheses H6 and H9 are also verified.

Grouped regression analyses

To analyze the moderating effects of contract complexity and task complexity further, the variables were grouped by adding or subtracting a standard deviation according to the mean. The samples are divided into high contract complexity and low contract complexity groups, and high task complexity and low task complexity groups. The results of the grouped regression analyses are shown in Figs 2 and 5.

Figs 2 and 3 show the moderating effects of contract complexity between contractor perfunctory behavior, opportunistic behavior, and EPVA respectively. In Fig. 2, although both sets of data show a positive correlation between contractor perfunctory behavior and EPVA, the line of the high contract complexity group is steep, indicating that the moderating effect of contract complexity which can strengthen the positive impact between perfunctory behavior and EPVA. Fig. 3 shows that the line of the high contract complexity group is gentler than the low contract complexity group, indicating that high contract complexity can weaken the negative impact between contractor opportunistic behavior and EPVA.

Figs 4 and 5 show the moderating effect of task complexity between contractor perfunctory behavior, opportunistic behavior, and EPVA respectively. The line of the low task complexity group is steeper than the high task complexity group in Fig. 4, indicating that the positive impact between contractor perfunctory behavior and EPVA is weakened by task complexity. However, task complexity strengthens the negative impact between contractor opportunistic behavior and EPVA as shown in Fig. 5, because the line of the high task complexity group is steeper.

Based on the above analysis, the results of the research model hypothesis are shown in Table 5.

Discussion

This research mainly analyzed the difference in project value-adding performance for making different types of contractor behavior under the influence of different degrees of contract and task complexity. The study's results show that:

(1) The three types of contractor behavior have a significant impact on project value-adding performance, in which perfunctory behavior and consummate behavior have a significant positive impact on EPVA, and opportunistic behavior has a significant negative impact.

With the vigorous development of the construction industry, contract performance problems are gradually being exposed in the construction process; for example, a lack of awareness of contract performance and continual decrease in compliance rates. Many solutions have been proposed to solve these problems from different perspectives, most of which reflect the governance of contractor opportunist behavior to the point of having become the mainstream guiding ideology. However, the results of this study show that the effect of perfunctory behavior and consummate behavior on EPVA to be greater than opportunistic behavior - indicating that contractor perfunctory behavior and consummate behavior are the key driving forces behind project value-added performance.

This result also further confirms the view that, for example, incentives plays a positive role in preventing moral hazard and improving the relationship between engineering stakeholders, and hence improving project performance (Meng and Gallagher , 2012), and contractor production efficiency, cost and time control (Assaf et al., 2012). Wei (2012) believes that owners not only need to establish supervision measures to control contractor opportunism but also need corresponding incentive mechanisms to encourage contractors to actively promote project performance. Furthermore, in promoting China's *Belt and Road* and PPP projects, the integrated delivery contract mode has become the market mainstream, with the right to control projects being transferred to the general contractor. Therefore, contractor behavior is becoming increasingly important for project success, making it counterproductive for owners to continue relying on the traditional suppression of contractor opportunistic behavior to control project performance. In order to improve project performance and realize EPVA, owners need to shift their focus of project governance to motivating and inducing contractors to more active, especially consummate, behavior.

(2) There are significant moderating effects of contract complexity and task complexity on the relationship between contractor perfunctory behavior, opportunistic behavior, and project value-adding performance, but not of contractor consummate behavior. Consultation with several practitioners with rich engineering practice experience suggests the following rationale.

First, in terms of the moderating effect of contract complexity, the project contract is the basis of the transaction between the contracting parties, and project execution is mainly governed by a series of contract items to restrict the behavior of both sides. Controllability, as the inherent function of a contract, establishes a reward and punishment mechanism by defining the responsibilities and obligations of the parties involved. The higher the contract complexity, the more detailed the contract terms and conditions, and the clearer the functional mechanism, which reduces project risk and uncertainty. A good control system can not only play a role in regulating and guiding the behavior of the organization and its members, ultimately achieving the desired basic goals, but also generates normative effects for stakeholders, so they can better meet the interests of external stakeholders and bring about a certain "spillover effect". Therefore, the effect of contractor perfunctory behavior on project value-adding performance is substantively a "spillover effect", that is, it not only achieves the basic performance goals agreed in the contract, but also obtains benefits beyond these expectations. This result also confirms Su (2010) in the Chinese context, who points out that regulating employee role behavior can enhance corporate performance. Moreover, Williamson (1975) also points out a complete contract can reduce the uncertainty of decision making and thus inhibit opportunistic intentions. Similarly, Lu et al. (2016) claim that the integrity of contracts can play a role in governing contractor opportunistic behavior. Therefore, when contract complexity is relatively high, the negative impact of contractor opportunistic behavior on project value-adding performance will also be weakened. In general, therefore, contract complexity can moderate the relationship between contractor perfunctory behavior, opportunistic behavior, and project value-adding performance.

For the moderating effects of task complexity, previous studies indicate that the behavioral decision depends not only on the contract form and content, but also on the external performance environment (Ashill and Jobber, 2014). As a carrier of a transaction, tasks can generate transaction costs due to their complexity, because complexity increases the difficulty of decomposing and assigning tasks and aggravates the incompleteness of contracts, thus increasing the cost of transactions. When task complexity is relatively high, work performance may be quite low because contractors do not understand their own work content and their expected goals. Although owners may further invest resources to reduce task ambiguity during this period, output may still be less than ideal. Therefore, the influence of contractor perfunctory behavior on project value-adding performance decreases with task complexity, as the contract is rough and the punishment mechanism is still unknown, which means that more loopholes and opportunities are sought. This situation aggravates the possibility of contractor opportunistic behavior and exacerbates the negative impact on project value-adding performance.

Contract complexity and task complexity, therefore, cannot moderate the relationship between contractor consummate behavior and EPVA. With the continuous deepening of research into behavior selection theory, studies have found that the contract text and external environment are weak in explaining some behaviors. As a result, the theory of planned behavior is increasingly used to explain behavior choices, according to which, three variables can affect behavioral willingness and behavior: behavioral attitude, subjective norm, and perceived behavior control (Ajzen, 2002). Here, behavior attitude refers to a person's judgment of the level of behavior preferences or dislikes, subjective norm refers to the social pressure perceived by executing or failing to perform a specific act, and the perceived behavior control refers to the degree to which an individual perceives the easy or difficult way to perform a particular behavior. Contractor consummate behavior is a voluntary and active altruistic behavior that cannot be enforced by legal means in a contract (Jiang et al., 2016), so its willingness to act is largely unaffected by subjective norms and the control of perceived behavior, but depends on behavior attitude. Some studies have introduced organizational behavior research into the field of construction engineering, and pointed out that justice perception, reciprocity, and other internal feelings play a role in contractor active behavior (Ajibade et al., 2011). As a result, the two external factors of contract and task lack power in explaining the presence of contractor consummate behavior.

Implications for theories and practices

Theoretical contributions

First, this research contributes to the project governance literature by investigating the mechanism of how different types of contractor behavior affect engineering project value added (EPVA) performance. The results reveal that which and how contractor behaviors affect EPVA. Distinguishing from prior studies that divide contractor behavior into opportunistic behavior and cooperative behavior. This paper has extended these studies by dividing contractor behaviors into three types of perfunctory, consummate, and opportunistic behavior.

Second, compared with prior studies on project performance that only focus on the iron triangle target of quality, cost and time limit, this research further extend prior literature by showing that project value added performance. In addition, this research provides new perspectives for project value added performance researchers by combining with the owner demand and time dimensions, with the short-term goal of improving the owner's explicit demands clearly agreed in the current delivery contract, and the longer-term goal of realizing the owner's implicit demands that are not clearly agreed but nevertheless expected for future operations.

Third, further light is shed on the effect of contract and task complexity on governance mechanisms. There exists research how the contract and task can affect contractor behavior, but these overlook the connection between contractor behavior and project performance. This research corrects this lacuna by introducing contract complexity and task complexity as moderating variables.

Practical implications

This research also offers important practical implications for managers involved in construction projects. First, Chinese owners can benefit by realizing that contractors are likely to behave in perfunctory, consummate, and opportunistic ways. Owners should change from their traditional mode of project governance of restraining contractors' opportunistic behavior, to a new mode of governance that induces perfunctory and consummate behaviors. In previous studies, owners tend to emphasize the contract's control function as a means of reducing risk and to ensure the quality, cost, and duration of projects. However, the results of this study show that, under the significant impact of the three types of contractor's behaviors on EPVA, the effect of contractor perfunctory and consummate behaviors on projects is greater than contractor opportunistic behavior. This indicates that perfunctory and consummate behaviors are the key driving forces of

EPVA. Therefore, owners in future need to incentivize contractors to carry out such active behaviors as perfunctory and consummate behaviors when considering project value-adding performance.

Second, providing a more detailed contract can weaken the negative impact of contractor opportunistic behavior on value added performance of a complex project and strengthen the positive effect of contractor perfunctory behavior, as this can help clarify the rights and responsibilities of both parties, reduce loopholes in the contract, minimize project uncertainty, and reduce the latitude for speculation. This not only guides contractor perfunctory behavior to help meet the basic performance goals stipulated in the contract, but can also gain added value beyond that expected. At the same time, it also to some extent inhibits the opportunist behavior of contractors. Contractor consummate behavior is a voluntary and active altruistic that cannot be enforced by legal means in the contract, so its willingness to act largely depends on behavior attitude, such as having fair feelings, reciprocity, and other internal factors. Therefore, in order to induce the contractor into consummate behavior, owners should consider the contractor's likely affective response, understand the contractor's wishes by strengthening interpersonal and information communication between the two sides, and formulate an incentive policy.

Conclusion, limitations, and further study

This paper empirically tested the effect of contractor behavior on EPVA and the moderating effects of contract and task complexity by deeply analyzing the difference in EPVA when the contractor exhibits different types of behavior under the influence of different degrees of contract and task complexity. The results show that three types of contractor behavior have a significant impact on EPVA, and there are significant moderating effects of contract complexity and task complexity on the relationship between contractor perfunctory behavior, opportunistic behavior, and EPVA, but not of contractor consummate behavior. This research contributes to project governance and project performance literature.

The research is limited by all the respondents in the practitioner group being from Chinese construction enterprises, although the results revealed no significant differences between different types of respondents, indicating that practitioners involved provide representative opinions. Moreover, the situation in the global market is commonly the same for all international construction enterprise in different countries. The experience of the respondents therefore provides a reference for all practitioners, regardless of their nationalities. Future research needs to consider the characteristics of different enterprises and the actual conditions of different countries. The paper also only treats two contextual factors of task and contract complexity, while the contractor's own ability is an important additional factor, and further research is needed to investigate such other potential moderators. Despite these limitations, however, the study provides a useful reference for academe and practice for a deeper understanding of the way to improve project value-adding performance from the perspective of contractor behavior.

Supplemental Data

Appendixes S1 and S2 are available online in the ASCE Library (www.ascelibrary.org).

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Figure captions list

Table 1. Descriptive Statistics

Variable	Category	Number of	Percentage	Cumulative
Project role	Employer	94	32.41%	32.41%
	Contractor	129	44.48%	76.90%
	Others	67	23.10%	100%
Position	Project manager	36	12.41%	12.41%
	Department manager	112	38.62%	51.03%
	Project engineer	118	40.69%	91.72%
	Others	24	8.28%	100%
Working years	Less than 3 years	30	10.34%	10.34%
	3 years -5 years	40	13.79%	24.13%
	5 years-10 years	87	30.00%	54.13%
	More than 10 years	133	45.86%	100%
Education	Specialist and below	21	7.24%	7.24%
	Undergraduate	156	53.79%	61.03%
	Graduate and above	113	38.97%	100%

Table 2. Reliability and Validity Analysis of Variables

Variable name	Cronbach's α	KMO	Bartlett Spherical test	CFA	CR	AVE
Contractor perfunctory behavior	0.890	0.779	significant	qualified	0.924	0.753
Contractor consummate behavior	0.856	0.850	significant	qualified	0.897	0.636
Contractor opportunistic behavior	0.890	0.824	significant	qualified	0.924	0.752
EPVA	0.909	0.900	significant	qualified	0.925	0.583
Task complexity	0.831	0.780	significant	qualified	0.882	0.600
Contract complexity	0.871	0.838	significant	qualified	0.906	0.659

Table 3. Descriptive Statistics and Pearson Correlation Matrix

Variable	Mean	SD	CPB	CCB	COB	CC	TC	EPVA
CPB	3.92	0.66						
CCB	3.40	0.73	0.517***					
COB	3.17	0.97	-0.321***	-0.354***				
CC	3.82	0.63	0.311***	0.376***	-0.116*			
TC	3.68	0.67	0.310***	0.376***	0.086*	0.397***		
EPVA	3.35	0.71	0.327***	0.540***	-0.219*	0.376***	0.498***	

Note: CPB, CCB, and COB refer to the three types of contractor behavior: perfunctory, consummate, and opportunistic behavior respectively. CC, TC, and EPVA refer to contract complexity, task complexity, and engineering projects value added respectively. In addition,*, **, and *** are significantly correlated at the 0.05, 0.01, and 0.001 levels respectively.

Table 4. The Results of the Hierarchical Regression Analysis

Variable type	Variable	EPVA									
		Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
Control variable	Project role	0.045	0.006	0.058	0.034	0.043	0.032	0.034	0.043	0.032	0.034
	Position	-0.090	-0.025	-0.036	-0.014	-0.032	-0.063	-0.014	-0.032	-0.063	-0.046
	Education	-0.016	-0.064	-0.043	-0.053	-0.025	-0.063	-0.053	-0.025	-0.063	-0.053
	Working	0.076	0.050	0.063	0.053	0.062	0.047	0.053	0.062	0.047	0.058
Independent variable	CPB		0.327^{***}			0.287^{***}	0.265^{***}				
	CCB			0.540^{***}				0.213^{*}	0.286		
	COB				-0.219^{*}					-0.201^{*}	-0.252^{*}
Moderator	CC					0.306^{***}		0.221		0.220^{***}	
	TC						0.203^{***}		0.021		0.294^{***}
Interaction	CPB X CC					0.266^{***}					
	CPB X TC						0.168^{***}				
	CCB X CC							0.065			
	CCB X TC								0.079		
	COB X CC									-0.175^{*}	
	COB X TC										0.188^{*}
	R^2	0.008	0.013	0.024	0.011	0.023	0.026	0.039	0.048	0.028	0.031
	$\triangle R^2$	--	0.005	0.016	0.003	0.015	0.018	0.031	0.040	0.020	0.023
	$\triangle F$	--	2.998	4.045	25.476	23.372	7.952	5.435	21.245	18.624	6.228

Note: CPB, CCB, and COB refer to the three types of contractor behavior: perfunctory, consummate, and opportunistic behavior respectively. CC, TC, and EPVA refer to contract complexity, task complexity, and engineering projects value added respectively. In addition,*, **, and *** are significantly correlated at the 0.05, 0.01, and 0.001 levels respectively.

Table 5. Model Hypothesis and Results Analysis

Hypothesis	Path	Path coefficients	Significance level	Inference
H1	CPB to EPVA	0.327	<0.001	Supported
H2	CCB to EPVA	0.540	<0.001	Supported
H3	COB to EPVA	-0.219	<0.05	Supported
H4	CPB x TC to EPVA	-0.168	<0.001	Supported
H5	CCB x TC to EPVA	0.079	>0.05	Not supported
H6	COB x TC to EPVA	0.188	<0.05	Supported
H7	CPB x CC to EPVA	0.266	<0.001	Supported
H8	CCB x CC to EPVA	0.065	>0.05	Not supported
H9	COB x CC to EPVA	-0.175	<0.05	Supported

Note: CPB, CCB, and COB refer to the three types of contractor behavior: perfunctory, consummate, and opportunistic behavior respectively. CC, TC, and EPVA refer to contract complexity, task complexity, and engineering projects value added respectively .