# Trust and Project Success: A Twofold Perspective between Owners and Contractors

Weiping Jiang, Ph.D.[1]; Yujie Lu, Ph.D., A.M.ASCE[2]; and Yun Le, Ph.D.[3]

**Abstract:** This research examines the role and nature of the influential relationship between trust and project success in construction projects by using structural equation modeling (SEM) and a large-scale questionnaire survey. Such a relationship is investigated based on three key components: six antecedents of trust as independent variables (reputation, competence, integrity, communication, reciprocity, and contract), two types of trust as mediating variables (calculative and relative trust), and project success as a dependent variable. The results differentiate and compare the perceptions of trust for both owners and contractors in terms of their priority for antecedents of trust, the influential mechanism that connects trust with project success, and the numerical relationship between calculative trust and relational trust. For both parties, relational trust generates a higher impact on project success than calculative trust, but contractors perceived the relationship between relational trust and calculative trust as being linear while owners believed such a relationship is a quadratic function. This research provides new evidence to support the development of trust theory in the construction industry, and it can also help construction practitioners and policymakers to better understand the development and management of trust in the construction industry. **DOI: 10.1061/(ASCE)ME.1943-5479.0000469.** 

**Author keywords:** Project success; Structural equation modeling (SEM); Calculative trust; Relational trust; Construction industry.



## Introduction

Trust—a belief that someone is reliable and honest—is a prominent factor in determining the success of a project (Egan 1998; Latham 1994; Wong et al. 2005). Past studies have shown that trust can reduce transaction costs (Cummings and Bromiley 1996; Handy 1995; Williamson 1993), minimize monitoring and controlling efforts and an organization's operating costs (Chiles and McMackin 1996; Creed and Miles 1996; Cummings and Bromiley 1996; Uzzi 1997), lower opportunism (Williamson 1975), and boost collaboration efficiency (Gulati 1995; Mayer et al. 1995; McAllister 1995; Smith et al. 1995). In construction projects, trust can reduce confrontations among project participants, form good relationships, cultivate better contract negotiation (Zaghloul and Hartman 2003), and improve working efficiency for the project (Gulati 1995; Kadefors 2004; Karlsen 2008; McDermott et al. 2004, 2005; Rousseau et al. 1998). Lack of trust, on the other hand, may lead to adverse effects or even project failure.

Despite the impact that trust has on a project, the existing research on project management has paid relatively little attention to the concept of trust rather than traditional project management topics such as cost, schedule, and quality management (Jaafari 2003). For example, the project management body of knowledge (PMBOK), the most widely used guideline in project management, has rarely investigated trust and its impact on project success. Several past studies have developed the concept, causes, and effects of trust in construction projects (Khalfan et al. 2007), such as "Trust in the construction project," (McDermott et al. 2005) supported by the Engineering and Physical Sciences Research Council (EPSRC) in the United Kingdom. However, limited research has focused on the empirical examination of the effect of trust on project success in different roles, especially to compare between the perspectives of owners and contractors.

This study aims to use the empirical research method—specifically, structural equation modeling (SEM)—to investigate the relationship between trust and project success for both owners and contractors. The results can provide a quantitative development pattern for establishing a reliable trust to achieve project success and also offer differing strategies for different construction parties to enhance trust in construction projects.

This research is presented as follows. The next section reviews the development of trust theory, various trust theory schools, and trust in the construction industry. The following section establishes the SEM framework to capture the impact of trust on project success and introduces the hypotheses on measurement and the assumptions of the SEM model. Then, the survey design, data collection, and the pilot test have been presented to support the formation of the SEM model, followed by the report of the calculation process, model validation and revision, and the final results of the SEM model. The last two sections discuss key findings from the results, summarize the study, and provide recommendations for future research.

## Literature Review

### *Research History*

The research on trust was initiated from social psychology in the 1950s. The American psychologist Deutsch started research on interpersonal trust (Deutsch 1958), followed by Hovland and Weiss (1951) and Hovland et al. (1953), who studied source credibility. Based on these early studies, Rousseau et al. (1998) proposed a

[1]Lecturer, School of Civil Engineering, Shenzhen Univ., Shenzhen, Guangdong 518060, China. E-mail: swingopen@szu.edu.cn

[2]Assistant Professor, Dept. of Building, National Univ. of Singapore, 4 Architecture Dr., Singapore 125677 (corresponding author). E-mail: luy@nus.edu.sg

[3]Professor and Head, Dept. of Construction Management and Real Estate, Tongji Univ., Shanghai 200092, China. E-mail: yunle@kcpm.com.cn

Note. This manuscript was submitted on October 8, 2015; approved on April 6, 2016; published online on June 22, 2016. Discussion period open until November 22, 2016; separate discussions must be submitted for individual papers. This paper is part of the ***Journal of Management in Engineering***, © ASCE, ISSN 0742-597X.

formal definition of trust as follows: "Trust is a psychological state comprising the intention to accept vulnerability based upon positive expectations of the intentions or behavior of another."

In addition to psychologists, a variety of scholars have also examined trust in different disciplines. Social scientists normally put trust in a multiperspective context and investigate how trust is impacted by different dimensions, such as social history, culture, and institutions (Fukuyama 1995; Quddus et al. 2000). Economists have used trust in game theory development (Coleman 1988; Herold 2010; Williamson 1993). In this research, trust is interpreted as a comprehensive inclusion of the above concepts applied in the construction industry, and it represents assured reliance on the character, ability, strength, and integrity of a construction participant. It consists of the personal psychological state, cross-organizational recognition, and institutional consideration.

### Types of Trust

Trust can be categorized into different types. For instance, it can be grouped based on different strength and intensity scales (Barney and Hansen 1994), on organizational perspectives (Lau and Rowlinson 2009), or on development stages (Shapiro et al. 1992). Although there is no universal method for categorizing trust types, increasingly scholars have categorized trust by its content (Lewis and Weigert 1985; Rousseau et al. 1998; Williamson 1993). The comparison of different types of trust is summarized in Table 1. Interestingly, all grouping methods can be universally aligned with the classification developed by Rousseau et al. (1998), which described trust as calculative trust, relational trust, and institutional trust. This research endorses this classification method and defines each of the trust components as follows. Calculative trust is decided based on the logical reason or the fact; relational trust is based on individual feelings, senses, and relationships; and institutional trust is established by organizational regulations, norms, and cultures at the organizational level rather than at the individual level (Rousseau et al. 1998).

### Trust in the Construction Industry

Existing research has explored antecedent factors of trust for construction stakeholders. Hartman (2000) explained why people trust and proposed three kinds of trust, including competence trust, ethical trust, and emotional trust. Cheung et al. (2014) identified five antecedents of trust, which consist of commitment, risk-taking, knowledge, honesty, and benevolence. Karlsen (2008) described essential factors for building trust in a project-stakeholder relationship, which include reliable behavior, communication skills, sincerity, showing commitment, benevolence and competence, showing

**Table 1.** Definition of Different Types of Trust

| Scholars | Types and definitions of trust |
|---|---|
| Rousseau et al. (1998) | • *Calculative trust* is based on rational choice, emerges when the trustor perceives that the trustee intends to perform an action that is beneficial<br>• *Relational trust* derives from repeated interaction over time between trustor and trustee, it is based on emotion and relationship<br>• *Institutional trust* is a control manifested in laws and reputational sanctions, acts as a deterrent from opportunism |
| Williamson (1993) | • *Calculative trust* means that the probability that we perform an action that is beneficial or at least not detrimental to us is high enough for us to consider engaging in some form of cooperation with him<br>• *Personal trust* as a passion warranted for very special personal relations that would be degraded if a calculative orientation were permitted<br>• *Institutional trust* refers to the social and organizational context within which contracts are embedded |
| Shapiro et al. (1992) | • *Knowledge-based trust* occurs when we predict, specifically, that another will behave cooperatively<br>• *Identification-based trust* assumes that one party has fully internalized the other's preference. Based on social psychology, people in the same group tend to behave in a more trustworthy manner toward each other than toward others not in the group<br>• *Deterrence-based trust* emphasizes utiliarism considerations that enable one party to believe that another will be trustworthy, because the costly sanctions in place for breach of trust exceeds any potential benefits from opportunistic behavior |
| Lewis and Weigert (1985) | • *Cognition-based trust* is motivated primarily by good rational reasons<br>• *Affect-based trust* is motivated primarily by strong positive affect for the object of trust |
| Lewicki and Bunker (1994) | • *Calculus-based trust* is founded on consistency and on deterrence ensuring the other's consistency through costs of inconsistency<br>• *Knowledge-based trust* relies on information, it is grounded in the other's predictability<br>• *Identification-based trust* is based on identification, that is, a full internalization of the other's desires and intentions |
| Sako (1992) | • *Contractual-based trust* arises from the explicit written or oral agreements that a party will stick to the contracts or initial understanding<br>• *Competence-based trust* is based on the expectation that a party will perform its role competently.<br>• *Goodwill-based trust* is a less self-interested, nonegotistic form of trust, there are no explicit promises that are expected to be fulfilled, nor fixed professional standards to be reached |
| Hartman (2000) | • *Competence trust* is based on the perception of others' ability to perform the required work<br>• *Intuitive trust*, also referred to as emotional trust, is founded upon the party's prejudice, biases, or other personal feelings toward the counterparts<br>• *Integrity trust*, also referred to as ethical trust, is based on the perception of others' willingness to protect the interests of their counterparts over the construction project |
| Cheung et al. (2014) | • *Cognition-based trust* is grounded in reliability and dependability, as well as competence<br>• *Affect-based trust* manifests as reciprocal interpersonal care, concern, and emotional bonds<br>• *System-based trust* emphasizes trust on the integrity of system rather than trust in a particular person |

and acting with integrity, working toward reaching project milestones, and establishing common goals. Khalfan et al. (2007) stated that past experience, problem resolving, shared goals, reciprocity, and reasonable behavior are keys to building trust for construction relationships. Wong et al. (2000) and Shaw (1997) proposed three antecedents of trust—accomplished results, integrity between words and behavior, and the showing of care—and validated them using Singapore public construction projects. Wood and McDermott (1999) stated that goodwill, commitment, and *sacrificing behavior* are vital in building and maintaining a trust relationship. They also referred five antecedents of trust in the UK construction industry as sacrificing behavior, problem solving, reputation, interaction between business and social relationships, and long-term relationships. Among them, the reputation was considered the most significant influence (Gambetta 1988). McDermott et al. (2005) listed five characteristics of a trusting relationship in construction projects: competence/reputation/reliability, promise-keeping, confidence, communication, and reciprocity.

Previous scholars have also discussed the relationships, influential mechanisms, and consequences of trust for trustors who grant the trust and trustees who receive the trust. Wood and McDermott (1999) proposed that a trustor typically has a strong dependence on a trustee to achieve certain outcomes that the trustor needs. Khalfan et al. (2007) pointed out that the process of trust building comprises three components: communication, behavior, and outcome. Trust occurs when the information is reliable in communication; trust increases when people keep their promises; and trust is in danger when the outcome does not meet expectations. Lau and Rowlinson (2009) analyzed trust in the context of real construction projects and found out that a climate of trust on a project can reduce contractual disputes, save project time and cost, and improve construction quality. In addition, trust can cultivate a harmonious environment in which all project participants can easily collaborate and form committees to carry out their responsibilities.

In addition, prior research has studied the roles and effects of trust in the construction organizations and the influence of trust on intraorganizational relationship (Buvik and Rolfsen 2015; Cheung et al. 2013; Chow et al. 2012; Ke et al. 2015; Khalfan et al. 2007; Meng 2012; Wong and Cheung 2004, 2005; Wong et al. 2008). For instance, Wong et al. (2000) studied the intraorganizational trust within an individual organization from the public agencies in Singapore's construction industry. Yean Yng Ling and Bao Tram Tran (2012) studied various approaches to promote trust in the construction project teams in Vietnam.

Several studies elected to focus the trust on the owner's perspective (Cheng and Li 2004). For instance, Badenfelt (2010) found that owners may better leverage the effective control strategies and gain more trust from contractors. Most of these studies used one or two events, such as project bidding, to indirectly contextualize the trust, but they did not provide the holistic view of the owner's perspective on trust. On the contrary, a few studies investigated the trust from the contractor's perspective by using indirect measures (Wong et al. 2005), such as from the constructor's decision-making process (Lowe and Parvar 2004).

So far, several studies have discussed the trust from both owners' and contractors' perspectives. For instance, Pinto et al. (2009) qualitatively described the understanding of both parties on the trust relationship. Bresnen and Marshall (2000) used a case study in the United Kingdom to illustrate the trust-based partnership and its collaboration. Anvuur and Kumaraswamy (2007) introduced the importance of trust between the construction and client in the long-term partnering and alliancing relationship.

However, in spite of the above-mentioned research, previous studies have done little to empirically compare the different perspectives between owners and contractors when linking trust and project success. To fill this gap, this research aims to use a large-scale survey to empirically investigate the above relationship using a quantitative SEM model. Because of the different perspectives of trustors and trustees, two different models—an owners' model and a contractors' model—are presented separately for construction projects. The model establishment is presented in the next section.

## Model Establishment

### Model Framework

This study examines the relationship between trust and project success in three parts: the antecedents of trust, the classification of trust, and project success. The antecedent of trust is the sources of trust, which include the characteristics of trustees, the characteristics of trustors, and the characteristics of the relationship between the trustees and trustors. After reviewing the past literature of trust in the construction industry, the antecedents of trust can be categorized into three aspects: the characteristic of trustees, the characteristic of the relationship between trustors and trustees, and the characteristic of trustors. However, the characteristic of trustors is typically not considered in the antecedent analysis of trust (Mayer et al. 1995). So this study followed the conclusion of the previous research and defined the research scope accordingly. A summary of other antecedents of trust is shown in Table 2.

As shown, there are various interpretations and categories for the antecedent of trust, and therefore, it is difficult to operationalize each of these antecedents in the empirical test. Construction professionals and experts were interviewed to select the most important antecedents (see interview details in the section titled "Questionnaire Design"). After interviewing and discussion, three characteristics of trustees were selected: reputation (Wood and McDermott 1999), competence (Karlsen et al. 2008; Wood and McDermott 1999), and integrity (Wong et al. 2000). Similarly, three characteristics of the relationship were chosen, and they consisted of communication (Karlsen 2008; Wood et al. 2002), reciprocity (Khalfan et al. 2007; Wood and McDermott 1999), and the contract (Jannadia et al. 2000; Thompson et al. 1998).

The trust classification follows the method proposed by Rousseau et al. (1998), which includes three elements—calculative trust, relational trust, and institutional trust. It should be mentioned that since this research primarily focuses on the Chinese construction industry, construction organizations have been previously reported to have little institutional trust (Child and Möllering 2003; Peng 1999). One key reason is that Guanxi (relationship) roots deeply in China's society and culture. Such a fundamental impact is argued as a barrier to hinder the establishment of institutional trust in China (Redding 1990; Whitley 1991). In addition, based on the authors' past experiences and observations, institutional efforts (i.e., legal actions) were rarely used in the construction projects rather than noninstitutional efforts, such as competence and reputation, to reach or execute a project contract in China. As a result, the institutional trust is ignored in the research design process, and only two types of trust—calculative and relational trust—are considered in this research. The full impact of trust on project success will be elaborated in the next section.

### Hypotheses

#### Antecedents of Trust

This research identifies six antecedents of trust and assumes their hypothetical relationships with both calculative trust and relational

**Table 2.** Antecedent of Trust in the Construction Intraorganizations

| Types | Antecedents of trust | References |
|---|---|---|
| The characteristic of trustees | Commitment, risk-taking, knowledge, honesty, and benevolence | Cheung et al. (2014) |
| | Results, *integrity*, and concern | Wong et al. (2000) |
| | Reliable behavior, communication skills, sincerity, showing commitment, benevolence and *competence*, showing and acting with *integrity*, working toward reaching project milestones | Karlsen (2008) |
| | Accomplished results, *integrity* between words and behavior, and the showing of care | Shaw (1997), Wong et al. (2000) |
| | Goodwill, commitment, and sacrificing behavior | Wood and McDermott (1999) |
| | Sacrificing behavior, problem solving, *reputation* | Wood and McDermott (1999) |
| The characteristic of the relationship between trustors and trustees | *Communication* | Karlsen (2008), Wood et al. (2002) |
| | *Communication* and long-term relationship | Wood and McDermott (1999) |
| | Establishing common goals | Karlsen (2008) |
| | Past experience, problem resolving, shared goals, *reciprocity* | Khalfan et al. (2007), Wood and McDermott (1999) |
| | The *contract* | Jannadia et al. (2000), Thompson et al. (1998) |

Note: Italicized words were final selected antecedents of trust in the questionnaire.



trust as follows. Reputation, competence, and integrity belong to an individual's characteristics, while communication, reciprocity, and the contract are mutual characteristics between the two parties.

1. Reputation and trust

   Reputation is defined as the impression a person makes on others because of his or her characteristics and trade behavior (Massa and Simonov 2003). Briefly, reputation is a public comment on a person, and it can inspire trust in the beginning of a project. Chiles and McMackin (1996) described trust as a signal to other actors—both those who have interacted with the party in the past and those who have not—of a party's trustworthiness based on its prior history of trustworthy behavior. For trustees, trust is an asset formed by long-term investment, and it is believed that it is not easily destroyed (Wood et al. 2002). Therefore, it is reasonable to assume that the reputation will contribute to both calculative and relational trust. Meanwhile, Wilson (1995) held that reputation is a positive attribute of an entity. The better the reputation, the more trust will be established for the entity. This positive correlation is testified to in many past studies (Achrol 1997; Bennett and Gabriel 2001; Hatch and Schultz 1997; Moorman et al. 1992; Wilson 1995) and is based on these studies, with the hypotheses on the relationship between reputation and trust being as follows:

   H1a: The better the reputation a trustee has, the more calculative trust the trustee will receive from a trustor.

   H2b: The better the reputation a trustee has, the more relational trust the trustee will receive from a trustor.

2. Competence and trust

   Competence is the trustee's skill or influence in one field or the probability of completing projects (Mayer et al. 1995). Sako (1992) proposed a competence-based trust for organizations, and many other scholars believe that competence is a key antecedent of trust (Booth 1998; Butler and Gill 1995; Cook and Wall 1980). Competence in the construction industry is commonly judged based on completion of a given project specified by a client (Wong et al. 2005). Generally, the stronger the competence, the higher the probability that an actor can complete its work. Wood et al. (2002) considered that competence means making the other party satisfied with a piece of work or creating added value for the other party in a construction project. If a party does not have the ability to accomplish the work, the other party will not establish a trusting relationship. For the relationship between a client and a contractor, the client relies on the contractor to complete construction projects, and the contractor relies on the client to provide income. Such an interdependent relationship is the precondition of trust, in which one party must present certain competence that can be counted upon by another party. Therefore, the next hypotheses can be stated as follows:

   H2a: The more competence a trustee has, the more calculative trust the trustee will receive from a trustor.

   H2b: The more competence a trustee has, the more relational trust the trustee will receive from a trustor.

3. Integrity and trust

   Integrity is a critical factor for establishing trust among project stakeholders in construction projects (Karlsen 2008). Integrity in construction projects refers to keeping one's promise and being consistent between one's words and actions. Wood et al. (2002) found that integrity is a key characteristic for trustees because if a trustee does not fulfill its promise, trust is difficult to establish between the two parties. In construction projects, when the promise cannot be achieved, it could bring damages to the construction project as well, such as schedule delays or cost overruns. Wong et al. (2000) validated this argument by using public infrastructure projects in Singapore. Therefore, it can be assumed that integrity contributes to both calculative and relational trust, as stated in the following proposed hypotheses:

   H3a: The more integrity a trustee has, the more calculative trust the trustee will receive from a trustor.

   H3b: The more integrity a trustee has, the more relational trust the trustee will receive from a trustor.

4. Communication and trust

   Communication is another important factor for building trust (Karlsen et al. 2008; Khalfan et al. 2007; Wood et al. 2002). Karlsen (2008) stated that project communication skills play an important role in stakeholders' trust. Good communication delivers accurate and timely information, so the two parties can understand each other's requirements, and it promotes trust building. Wood et al. (2002) found that communication is a tool that can be used to create confidence between the parties involved in a project, so it is essential to keep the channels of communication open and working smoothly. If one party lies, trust quickly disappears and cannot be recovered. However, research has found that poor communication also leads to the breakdown of all four major issues of

trust—circumstances beyond control, understanding that mistakes can happen, fair representation, and fixing problems (Khalfan et al. 2007). It is therefore proposed that communication can promote both calculative trust and relational trust, as stated in the following hypotheses:

H4a: The better the communication, the more calculative trust a trustee will receive from a trustor.

H4b: The better the communication, the more relational trust a trustee will receive from a trustor.

5. Reciprocity and trust

Reciprocity is when one party has made sacrifices and the other responds after judgment (Malhotra 2004). One party will typically consider reciprocity before trusting the other party, and numerous researchers have shown that organizations and individuals are inclined to trust organizations or persons with high reciprocity (Andreoni 1995; Gneezy et al. 2000; Pruitt and Kimmel 1977; Snijders and Keren 1999).

Reciprocity is extremely important for the relationship between the owner and the contractor because there are many uncertainties in construction projects, and both parties need to consider each other's interests in facing these uncertainties. For example, when the contractor is in financial difficulty, the owner would like to provide financial support. In return, the contractor may speed up the construction process for future projects. Also, all of these actions are reciprocal. One party will not always sacrifice its interests unless the other party behaves in a reciprocal way. If the other party will not do so, the trust will decrease. In construction projects, the two parties equally use each other's advantages to satisfy their own interests (Wood et al. 2002), and thus reciprocity relates to both relational and calculative trust, as stated in the following hypothesis:

H5a: The more reciprocity there is, the more calculative trust a trustee will receive from a trustor.

H5b: The more reciprocity there is, the more relational trust a trustee will receive from a trustor.

6. Contract and trust

The contract has complex effects on trust. On one side, a complete contract is beneficial to building calculative trust. Sako (1992) stated that contractual trust—i.e., expectations that a promise made will be kept—is necessary for the smooth working of any working relationship. Detailed items of the contract can prearrange treatments when problems arise, and this can reduce risks.

On the other side, however, some scholars have argued that in a complete contract where responsibility and risk are clearly stated, such a contract may decrease the probability of mutual sharing and eventually does harm to relational trust. Herold (2010) pointed out that a complete contract, including explicit penalty and incentive clauses, is an expression of distrust. Zaghloul and Hartman (2003) also argued that that contract is the cost of mistrust. Lyons and Mehta (1997) held a similar view and thought that a contract with detailed terms is harmful to goodwill and trust production for three reasons. First, too many terms may narrow understanding of the contract, which may violate the original intention. Second, fixed terms may decrease reciprocal behaviors by both parties when uncertainties arise. Third, a complete contract that considers failure situations may produce mistrust. Overall, the contract has complex influences on the two types of trust. A complete contract is assumed to be positively related to calculative trust and negatively related to relational trust, as stated in the hypotheses below.

H6a: The more complete a contract is, the more calculative trust a trustee will receive from a trustor.

H6b: The more complete a contract is, the less relational trust a trustee will receive from a trustor.

### Calculative Trust and Relational Trust

Trust development has three stages (Lewicki and Bunker 1994). In the early stage of trust, there is high calculative trust and low relational trust because both parties are unfamiliar with each other. Their collaboration can only be based on the calculative benefits from the other party. In the middle stage, when both the communication and understanding of the parties increase, more relational trust will be established. Finally, in the late stage, relational trust will become more important than calculative trust.

This trend is quite similar to that in construction projects. In the early stage of a construction project, the owner and the contractor are often unfamiliar with each other, so calculative trust becomes the primary type of trust. Both parties scrutinize their interests and risks and consider whether the other party has the ability to complete the terms of the contract. Along with the progress of the project and constant communication, both sides establish close working and personal relationships with each other. The greater relational trust will then emerge, and at that time, one party may make a compromised action when dealing with the other's difficulties based on mutual understanding and reliance accumulated previously. Based on this argument, the hypothesis for the relationship between calculative trust and relational trust is stated as follows:

H7: The more calculative trust there is, the more relational trust there will be.

### Trust and Project Success

Many factors may influence the project success so currently no consensus exists about the criteria of project success. Project success is traditionally measured by factors such as time, cost, and quality (Papke-Shields et al. 2010). These criteria are often named as an *iron triangle* (Meredith and Mantel 2011; Pinto and Slevin 1987). In the last decades, scholars suggested adding additional dimensions to measure the project's success. For instance, Yang et al. (2012) incorporated safety and project profit to evaluate project success. Shenhar et al. (2001) argued that projects are strategic so project success should be assessed according to short-term and long-term project objectives, including efficiency to meet schedule and budget goals, impact on customers' benefits and needs, business success in commercial value and market share, and the preparation for the future in creating new technological and operational infrastructure and market opportunities. Additionally, project success may also be interpreted as a subjective term and vary largely depending on the context and the perspectives of stakeholders, such as clients, contractors, and consultants (Iyer and Jha 2006). Researchers, such as Chou and Ngo (2014) and Dvir et al. (2006), have recommended using stakeholder satisfaction to measure project success. After reviewing all the above studies, this study selected nine dimensions to measure the success of a project. They are listed in the last row of Table 3.

In reviewing of literature, both types of trust are critical to project success. Wong and Cheung (2005) showed a positive relationship between trust and project success, but their conclusion did not separate the differences among types of trust. Calculative trust is based on human rationality and considers how the other's behavior will benefit one's own interests. Relational trust is the result of the goodness of working together—i.e., interpersonal relationships—which make the project progress more smoothly. Relational trust can promote cooperation between two parties, improve the project team's coordination, and help in the development of shared goals to

**Table 3.** Measurement for the Antecedents of Trust, Types of Trust, and Project Success

| Variables | Measurement and notation used in the model | Referred sources |
|---|---|---|
| The reputation of the trustee (REP) | The other party has a reputation for being honest (REP1) | Doney and Cannon (1997) |
| | The other party is known to be caring for other's interests (REP2) | |
| | The other party is acknowledged by most cooperative companies (REP3) | |
| | The other party is considered as fair in the industry (REP4) | Interview |
| The trustee's (the contractor) competence (C-COM) | The contractor has similar project experience (C-COM1) | Cheng and Li (2004), Hatush and Skitmore (1997, 1998), Mahdi et al. (2002), Palaneeswaran and Kumaraswamy (2000), Singh and Tiong (2005, 2006) |
| | The contractor's financial status is stable (C-COM2) | |
| | The contractor's human resource is abundant (C-COM3) | |
| | The contractor has good management and technology ability (C-COM4) | |
| | The contractor has good safety and health records (C-COM5) | |
| The trustee's (the owner) competence (O-COM) | The owner's financial status is stable (O-COM1) | Interview; Lim and Ling (2002), Lowe and Parvar (2004), Soetanto and Proverbs (2002) |
| | The owner can quickly complete payment (O-COM2) | Lowe and Parvar (2004) |
| | The owner has strong ability in scope management(O-COM3) | Lim and Ling (2002) |
| | The owner has similar experience (O-COM4) | Lowe and Parvar (2004) |
| | The owner has strong onsite coordination ability (O-COM5) | |
| The integrity of trustee (WOR) | The other party can fulfill its promise under normal conditions (WOR1) | Interview |
| | The other party acts in accordance with the standards of morality, and its behavior is predictable (WOR2) | |
| | The other party can keep the promise even without supervision (WOR3); | |
| | When an accident occurs, the other party can inform us immediately and act accordingly (WOR4) | |
| | The other party behaves unpredictably and inconsistently with the words (R*) (WOR5) | |
| Communication (COM) | Two parties communicate with high frequency and good effect (COM1); | Wong and Cheung (2005) |
| | Two parties communicate openly and frankly (COM2) | |
| | Two parties efficiently and adequately share the information (COM3) | Swan et al. (2002) |
| | Two parties communicate in a timely manner (COM4) | Lin (2002) |
| | The information in communication is accurate (COM5) | |
| | The other party will hide information for us for their own interest (R*)(COM6) | Interview |
| | Conflicts can be resolved in communication (COM7) | |
| Reciprocity (REC) | When dealing with uncertainty, one party will consider other party's interest (REC1) | Interview |
| | One party would provide help when the other party faces problem (REC2) | |
| | One party would return the interest to the other party who provide the help (REC3) | |
| | When one party sacrifices for the project, the other party will also make similar sacrifices. (REC4) | |
| Contract (CON) | The contract is determined before the beginning of the project (CON1) | Interview; Bonet et al. (2001) |
| | The contract brings confidence for both parties (CON2) | |
| | There still exist inexplicit terms in the contract (R*) (CON3) Pinto et al. (2009) | |
| | All contractual item are fair (CON4) | |
| Calculative trust (CAL) | I assure that the other party has the ability to effectively perform the work (CAL1) | Pinto et al. (2009) |
| | I believe that the project engineers and technical professionals are competent (CAL2) | |
| | Given the previous track records of other party, I see no reason to doubt their competence and preparation for this project (CAL3) | |
| | I assure that the contract is complete (CAL4) | Handfield and Bechtel (2002) |
| | We believe that the other party will abide by the contract (CAL5) | Zaheer et al. (1998) |
| | We believe that the other party's cost for breaching contract is high (CAL6) | Yang (2006) |
| Relational trust (REL) | We believe the other party will keep the promise during the project execution (REL1) | McAllister (1995) |
| | We believe the other party will follow the standard of moral during the project execution (REL2) | |
| | We believe the other party is trustful (REL3) | |
| | We believe the other party is fair (REL4) | |
| | We believe the other party will care about our interests during the project execution (REL5) | |
| | We believe the other party will not exploit us to maximize profits (REL6) | |
| | We believe the other party brings professionalism and dedication to the project (REL7) | |

**Table 3.** (*Continued*.)

| Variables | Measurement and notation used in the model | Referred sources |
|---|---|---|
| Project success (SUC) | This project progress follows schedule (SUC1) | Pinto et al. (2009) |
| | This project cost is within budget (SUC2) | |
| | The project deliverable meets client's objectives (SUC3) | |
| | The project is performed as intended (SUC4) | |
| | The project can solve most problems encountered during the project execution (SUC5) | |
| | The project process is satisfied (SUC6) | |
| | This project creates positive impacts on end users (SUC7) | |
| | The owner is satisfied with the project results (SUC8) | |
| | We are optimistic about the success of this project (SUC9) | |
| | We are likely to cooperate with the other party again in the future (SUC10) | Interview |

Note: R* = reverse terms or measures.

achieve project success. Based on the above arguments, this study assumes that both calculative and relational trust are positively related to project success, as described in the following hypotheses:

H8: The more calculative trust a trustee receives from a trustor, the greater will be the probability of success of a project.

H9: The more relative trust a trustee receives from a trustor, the greater will be the probability of success of a project.

Combined with the above discussion, a conceptual model has been developed to articulate the relationship between trust and project success (Fig. 1).

### Measures

The measures for the above hypotheses and variables come from two sources: a systematic literature review and field interviews of construction professionals working in China. The interview process and the respondents are further discussed in the next section, and the final measures are shown in Table 3. There are 34 measures for the antecedents of trust: six measures for calculative trust, seven measures for relational trust, and ten measures for project success. It is noteworthy that the measurement of competence is designed in two versions—for owners and contractors, respectively, based on their different capacities.

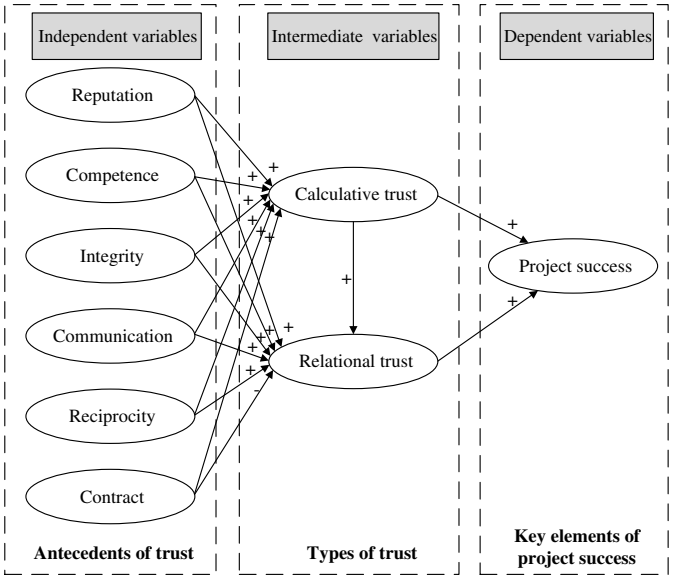


**Fig. 1.** Conceptual model for the relationship among antecedents of trust, types of trust, and project success

## Questionnaire Design, Data Collection, and Pilot Test

There are six steps in using SEM for empirical study: (1) questionnaire design, (2) pilot testing, (3) large-sample data collection, (4) running of the model, (5) model validation and revision, and (6) analysis of the final results. This section covers the first three steps, and the following section covers the remaining steps.

### Questionnaire Design

The questionnaire was designed in four parts: (1) antecedents of trust for both parties, including reputation, competence, integrity of the trustee, communication, reciprocity, and the contract; (2) calculative trust and relational trust; (3) project success; and (4) basic information on survey respondents, including their positions, experience, project information, and enterprise background. It should be noted that from an owner's perspective the questionnaire intends to provide an understanding of how to trust a contractor; from a contractor's perspective, the questionnaire intends to provide an understanding of how to trust an owner.

A rigorous process was used to design the questionnaire survey. First, the existing literature was reviewed to draft preliminary questions, such as possible antecedents of trust and their links to project success. Then, four experts were invited for an interview to evaluate these questions and identified the ones they believed are the most important in China's context. Four experts were selected from China's construction industry, including two professors studying construction project management for more than 20 years, and two senior project directors from owners and contractors respectively with years of construction management experiences. A sample interview question was "what do you think are the most important factors to form the trust for owners/for contractors/and for the mutual relationship between owners and contractors?" After discussion and consensus by all interviewees, a pilot questionnaire was determined. Third, a pilot test was conducted, and the feedback was used to modify the questionnaire. After modification, the questionnaire was ready to use in collecting large-scale samples. The abridged version of a sample survey for contractors is provided for reference in the Supplemental Data (Tables S1–S3), which was distributed to and answered by owners.

### Pilot Test

The pilot test aims to verify and to assist in revising the draft questionnaire. The pilot test was implemented in Shanghai, China, and potential survey respondents were project managers who had work experience as owners or contractors. A total of 82 questionnaires

were sent to owners, and 50 were returned; 90 questionnaires were sent to contractors, and 57 were returned. After checking the validity of all returned questionnaires, 37 valid questionnaires from owners and 35 valid questionnaires from contractors were collected, for collection rates of 45% and 39%, respectively.

The pilot test was conducted in three steps. The first was to purify the latent variables and delete the items with low reliability. The indicators used were corrected-item total correlation (CITC) and measured by Cronbach's alpha ($\alpha$) reliability index. The value of $\alpha$ higher than 0.7 is regarded as good in reliability testing and was used as a cut-off point in this study (Cronbach 1951; Hair et al. 2006; Nunnally 1978). The value of $\alpha$ can be repeatedly tested for each item until the final selection where no redundant item exists. CITC refers to a correlation of an item with the composite score of all the items forming the same set. That the traditional cut-off point of CITC is 0.5 can be used as another measure to ensure minimal redundancy among selected items (Koufteros 1999; Lu et al. 2007). Second, the study used Kaiser-Mayer-Olykin (KMO), which should be greater than 0.6 (Kim and Mueller 1978), and the Bartlett Test of Sphericity, of which the significance should be less than 0.05 (Hair et al. 2006), as criteria to check the suitability for factor analysis. The third step was to run the factor analysis, and this study used the value of factor load of greater than 0.7 as the criterion to select eligible measures (Tinsley and Tinsley 1987). The results of the three steps in the pilot test can identify both valid and invalid measures. After rectifying all measures, the questionnaire is prepared for large-scale sample collection.

### Data Collection and Statistic Description

The survey was carried out in a systematic way between October 2008 and June 2009. The targeted respondents were drawn from owners' representatives, technical professionals, and managers from contractors. The sample size was determined by (1) the ratio of 5:1 between sample size and number of measure items (around 50 items), (2) a reasonable attrition rate due to invalid responses and so on, and (3) an approximate 50% response rate based on previous experiences. So a total of 1,210 questionnaires were decided to be sent out, 600 for owners and 610 for contractors.

These questionnaires were sent out by the authors and local construction-administrative bureaus to six major provinces (municipalities) in China, including Zhejiang, Jiangsu, Jiangxi, Shandong, Hubei, and Shanghai, which is a municipality and considered equally as a province. These provinces represented different levels of economic status and construction development. In each province, the questionnaires were sent with roughly equal distribution among large, medium, and small companies. The collection results were that 697 questionnaires were returned, including 342 from owners and 355 from contractors. Due to the assistance and support from these administrative authorities, the survey responses were considered to be reliable and trustworthy.

After collection, all questionnaires results were carefully examined to ensure validated responses by using the following principles: (1) deleting responses that left many options empty; (2) deleting responses that showed conflict in reverse wording of questions, which were purposely designed in the survey; (3) deleting responses that selected the "not sure" option many times; (4) deleting those that showed special shapes in answered papers; and (5) deleting identical responses. After validating all responses, 298 valid questionnaires from owners and 290 from contractors were finally accepted, for effective rates of 49.7% and 47.5%, respectively, which meet the requirement for questionnaire surveys (Hair 2010).

The data were also tested for normal distribution by using skewness and kurtosis analysis. The results showed that the absolute values of skewness and kurtosis were less than 1, so both of them satisfied the normal distribution, which requires 3 for skewness and 10 for kurtosis (Kline 2011). In addition, unbiased tests, which consist of nonresponse biased test and common method bias test, were performed to ensure the data are qualified. Therefore, all collected measures were in accordance with the normal distribution and were suitable for further analysis.

After the above validation tests, a brief statistical analysis was conducted to show basic information, such as the geographic distribution, respondent's positions, years of experience, company sizes, and project scales. For instance, the respondents were proportionally distributed in six provinces, including 26% in Shanghai, 25% in Zhejiang, 23% in Jiangsu, 16% in Shandong, 6% in Hubei, and 4% in Jiangxi. In the owners' sample, 49% of the respondents are project managers, 37% are department managers, and 14% are engineers. In the contractors' sample, 56% of the respondents are project managers, 36% are department managers, and 8% are engineers.

## Model Testing, Revision, and Results

### SEM Model

This study aims to analyze multivariate relations that include independent variables, mediators, and dependent variables. The SEM has been justified as an appropriate tool to tackle with this multivariate analysis (Hair Jr et al. 1995) because it can estimate multiple and interrelated dependence relationships, correct measurement errors in the estimation process, and define a whole model explaining the entire set of relationships (Hair et al. 2006). By explicitly accounting for the measurement errors in the variables, the SEM can produce an accurate representation of the overall results (Molenaar et al. 2000). In the last decades, SEM has been used widely in construction engineering management to investigate topics such as construction safety (Zou and Sunindijo 2013), stakeholder relationship (Cheng and Li 2002), project success (Tabish and Jha 2011), and especially for trust (Wong and Cheung 2005).

SEM contains measurement equations and structural equations. Measurement equations describe how to operationalize latent variables into measurable indicators by conducting confirmative factor analysis (CFA), which aims to test the reliability and justification of factors. CFA examines individual factors, group factors, and factor convergence. An individual factor is judged by its R square, which is supposed to be greater than 0.5 (Bagozzi and Yi 1988); a group factor is judged by the construct reliability, or named composite reliability (CR), which should be greater than 0.6 (Bagozzi and Yi 1988); the factor convergence is judged by the average variance extracted (AVE), with a value greater than 0.7 (Nunnally 1978) and a significance level of less than 0.05 (Fornell and Larcker 1981).

Structural equations describe and verify the relationships among variables by examining the goodness of fit between a theoretical model and actual collected data. The goodness of fit is evaluated by many indicators, such as $\chi^2/df$, which is less than 3 (Medsker et al. 1994); root mean square error of approximation (RMSEA), which is less than 0.1 (Steiger 1990); and other goodness indexes, which include a goodness-of-fit index (GFI) greater than 0.85, an adjusted goodness-of-fit index (AGFI) greater than 0.85, an *incremental*-fit index (IFI) greater than 0.85, and a *comparative*-fit index (CFI) greater than 0.85 (Bollen 1989).

It is worth mentioning that the above rules are still in debate by different scholars, so the SEM analysis should be understood and

**Table 4.** Results of the Original Model, First Revised Model, and Second Revised Model

| Relationship among variables | Hypothesis | Original model | | First revised model | Second revised model |
|---|---|---|---|---|---|
| | | Owner's response | Contractor's response | Owner's response | Owner's response |
| Independent variables' impact on intermediate variables | H1a | 0.254[a] | 0.344[a] | 0.253[a] | 0.267[a] |
| | H1b | 0.358[a] | 0.222[a] | 0.357[a] | 0.387[a] |
| | H2a | 0.360[a] | 0.435[a] | 0.356[a] | 0.369[a] |
| | H2b | 0.308[a] | 0.185[a] | 0.301[a] | 0.344[a] |
| | H3a | 0.419[a] | 0.203[a] | 0.420[a] | 0.430[a] |
| | H3b | 0.494[a] | 0.331[a] | 0.497[a] | 0.536[a] |
| | H4a | 0.383[a] | 0.420[a] | 0.383[a] | 0.391[a] |
| | H4b | 0.511[a] | 0.289[a] | 0.512[a] | 0.547[a] |
| | H5a | 0.417[a] | 0.290[a] | 0.418[a] | 0.421[a] |
| | H5b | 0.251[a] | 0.109[a] | 0.252[a] | 0.288[a] |
| | H6a | 0.412[a] | 0.268[a] | 0.413[a] | 0.425[a] |
| | H6b | 0.368[a] | 0.242[a] | 0.370[a] | 0.410[a] |
| Impacts of intermediate variables | H7 | 0.077 | 0.403[a] | 0.077 | N/A |
| Intermediate variables' impact on dependent variables | H8 | 0.167[a] | 0.267[a] | 0.148[a] | 0.168[a] |
| | H9 | 0.537[a] | 0.576[a] | 0.558[a] | 0.537[a] |
| Goodness of fit indexes | Chi square | 1.843 | 1.941 | 1.854 | 1.840 |
| | GFI | 0.780 | 0.816 | 0.775 | 0.807 |
| | AGFI | 0.767 | 0.788 | 0.753 | 0.781 |
| | RMSEA | 0.068 | 0.052 | 0.071 | 0.053 |
| | NFI | 0.827 | 0.909 | 0.736 | 0.873 |
| | IFI | 0.863 | 0.954 | 0.843 | 0.909 |
| | CFI | 0.851 | 0.954 | 0.841 | 0.909 |

[a]Significance level is less than 0.05.



interpreted with a holistic view together with real situations instead of as individual indicators. After setting all of the rules, the covariance-based SEM calculation was carried out using *Lisrel 8.50*, which is a professional software program designed for SEM analysis.

### Original Models, Verification Process, and Revised Models

The calculation was implemented separately for owners and contractors, and both sets of results are shown in Table 4. The model fitness indicators show unsatisfactory results for the models of both owners and contractors. Taking the owners' results as an example, although most path coefficients were significant, the value of GFI and AGFI were 0.780 and 0.767, which were less than 0.8 and thus require further improvement.

#### Revision of the Owner's Model

The typical reasons for poor fitting of the theoretical models could be that (1) the theoretical model may have missed certain key relationships (or paths) among variables, which means that the solution is to add those potential paths; or (2) the theoretical model may contain insignificant paths, which means that the solution is to delete these paths. The study tried both possible solutions as described below.

The first revised model was designed to explore and find possible new paths. In the original theoretical model, all paths departed from the independent variables toward the mediating variables, then to the dependent variables. The model does not consider the direct effects of independent variables on the dependent variables. Given the possibility of having such relationships, six additional paths from independent variables directly to the dependent variables were added to the original model in order to form the first revised model.

The results of the first revised model are shown in Table 4, and they reveal that all of the added paths are insignificant. This indicates that the independent variables do not have direct effects on the dependent variables, and so the 1st revised model is abandoned.

The second solution was to find insignificant paths in the original model. After review, the path from calculative trust to relational trust (H7) was identified as insignificant ($p$ value $= 0.832 > 0.05$), so the path was deleted. It can be interpreted that there is no linear relationship between calculative trust and relational trust in the owner's model. So the second revised model was formed. The new results, shown in Table 4, indicate that all paths are significant and that the GFI was improved by 3.3%, from 0.780 to 0.807. The second revised model was accepted as the final model to represent the owner's response.

#### Revision of the Contractor's Model

A similar revision was applied to the contractors' original model as well. First, the additional paths were added between the independent variables and the dependent variables based on the original model, but the revised results showed that all of the added paths were insignificant. In the second attempt, we reviewed all paths in the original model and found that all paths were significant. So, the original model satisfies all validation expectations and is accepted as the final model to represent the contractor's response.

### Final Results

The final results for owners' perceptions of trust and contractors' perceptions are shown in Figs. 2 and 3, respectively. All antecedents of trust have influence upon project success through the mediating variables, which are calculative trust and relational trust. For both results, all hypotheses are supported with high significance levels and goodness-of-fit indexes, except for the relation between the contract and relational trust (H6b). Unlike the null hypothesis, which assumes that a complete contract will negatively impact relational trust, the actual results for both owners and contractors show that they are positively related. This unexpected result will be further discussed in the next section.

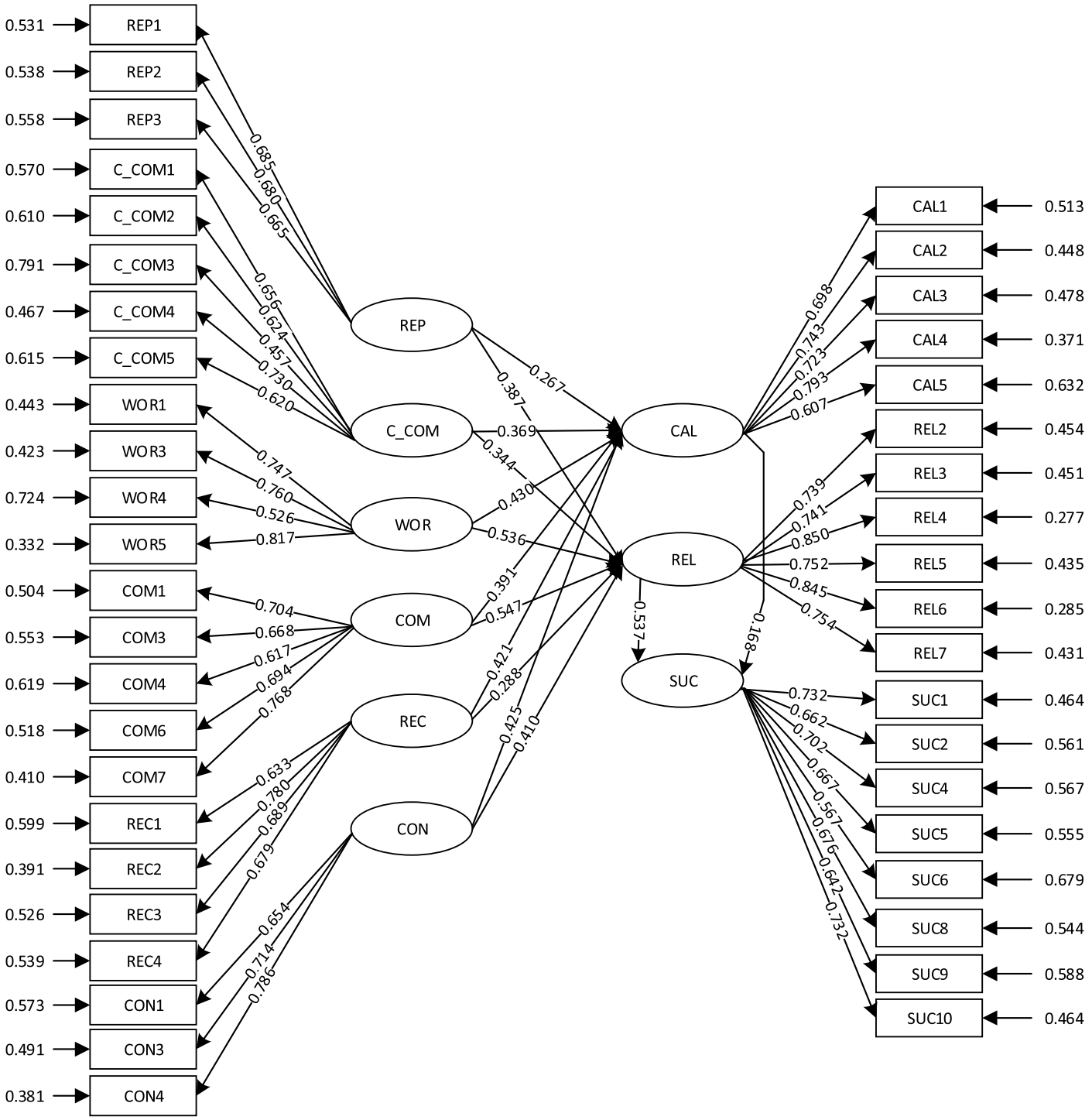


**Fig. 2.** Final SEM model for the owner's perception of the trust relationship

## Discussion

### *Different Perspectives between Owners and Contractors*

1. Antecedents of trust and types of trust

   Owners and contractors show significant differences in developing trust for another party. For relational trust, owners and contractors share similar results. The top concerns of both parties are communication and integrity. For calculative trust (Table 5), however, the two parties have different opinions. Owners put foremost their concerns about a contractor's integrity (0.43, which indicates the coefficient of the path and is the same for numeric notations hereinafter), project contract (0.425), and mutual reciprocity (0.421), while contractors are more concerned about the owner's competence (0.435) and communication (0.42).

   The differences could be explained as follows. For owners, due to the disadvantage of information availability, they can only trust contractors by observing how they actually behave in the working environment, whether they show integrity between their words and actions, and how they respond to the

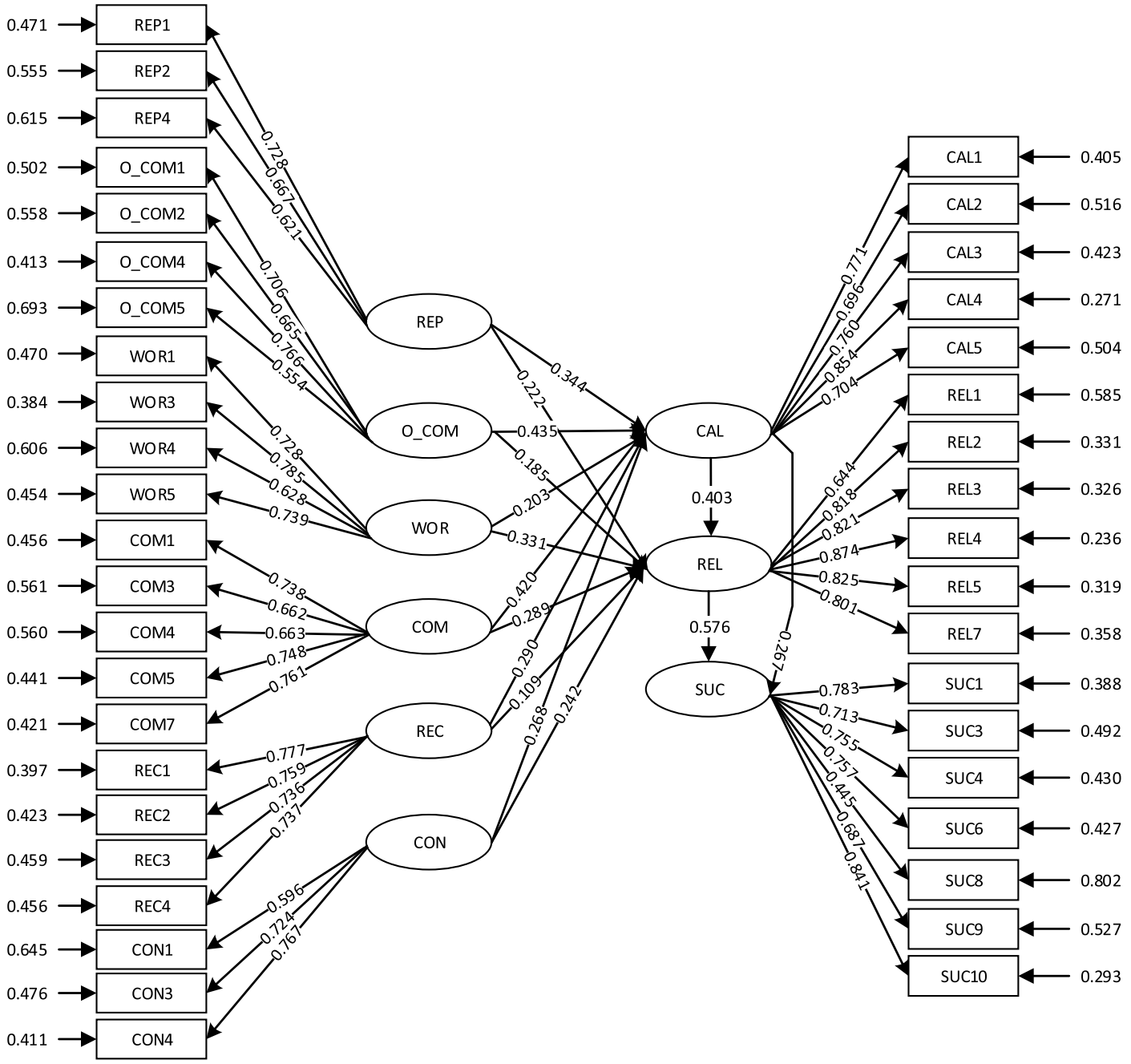


**Fig. 3.** Final SEM model for the contractor's perception of the trust relationship

other party's sacrifices or rewards. This is similar to previous studies, such as Pinto et al. (2009), in which integrity was witnessed to influence mutual relationship and on project success. Owners also rely on the written contract, which is a law-enforced document, to help them establish trust. Contractors, whose primary objective is to earn a profit, normally develop trust based on the owners' competence, such as their financial capability and past payment history. Contractors also care about the owner's communication skills, such as providing clear project objectives, schedule delay policies, and other requirements, echoing the similar conclusion of the path "interpersonal relationship-communication-success" proposed by (Diallo and Thuillier 2005).

2. Types of trust and project success

Establishing relational trust significantly contributes to a project's success for both owners (0.537) and contractors (0.576). One reason is that project success is largely based on bilateral satisfaction with completed jobs and possible opportunities for future cooperation.

Developing calculative trust, however, shows a largely varying impact for owners and contractors to achieve a project's success. Contractors' responses with regard to calculative trust (0.499) are three times higher than owners' responses (0.168). This indicates that the contractors are more likely to use calculative trust than owners and to believe that this will help produce project success. A possible reason could be that contractors make profits from the services they provided, in which they have advantages of information for knowing the

**Table 5.** Final Result for the Relations among Independent Variables, Intermediate Variables, and Dependent Variables

| | | | Intermediate variables | | | | | | Dependent variables | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Calculative trust | | | Relational trust | | | Project success | | |
| Respondents | Types of variables | Variables | Direct impact | Indirect impact | Total impact | Direct impact | Indirect impact | Total impact | Direct impact | Indirect impact | Total impact |
| Owner's response | Independent variables | Contractor's reputation | 0.267 | — | 0.267 | 0.387 | — | 0.387 | — | 0.252 | 0.252 |
| | | Contractor's competence | 0.369 | — | 0.369 | 0.344 | — | 0.344 | — | 0.246 | 0.246 |
| | | Contractor's integrity | 0.43 | — | **0.43** | 0.536 | — | **0.536** | — | 0.36 | **0.36** |
| | | Communication | 0.391 | — | 0.391 | 0.547 | — | **0.547** | — | 0.359 | **0.359** |
| | | Reciprocity | 0.421 | — | **0.421** | 0.288 | — | 0.288 | — | 0.225 | 0.225 |
| | | Contract | 0.425 | — | **0.425** | 0.41 | — | 0.41 | — | 0.292 | 0.292 |
| | Intermediate variables | Calculative trust | — | — | — | — | — | — | 0.168 | — | 0.168 |
| | | Relational trust | — | — | — | — | — | — | 0.537 | — | 0.537 |
| Contractor's response | Independent variables | Owner's reputation | 0.344 | — | 0.344 | 0.222 | 0.139 | 0.361 | — | 0.252 | 0.3 |
| | | Owner's competence | 0.435 | — | **0.435** | 0.185 | 0.175 | 0.36 | — | 0.246 | **0.324** |
| | | Owner's integrity | 0.203 | — | 0.203 | 0.331 | 0.082 | **0.413** | — | 0.36 | 0.292 |
| | | Communication | 0.42 | — | **0.42** | 0.289 | 0.169 | **0.458** | — | 0.359 | **0.376** |
| | | Reciprocity | 0.29 | — | 0.29 | 0.109 | 0.117 | 0.226 | — | 0.225 | 0.208 |
| | | Contract | 0.268 | — | 0.268 | 0.242 | 0.108 | 0.35 | — | 0.292 | 0.273 |
| | Intermediate variables | Calculative trust | — | — | — | 0.403 | — | **0.403** | 0.267 | 0.232 | 0.499 |
| | | Relational trust | — | — | — | — | — | — | 0.576 | — | 0.576 |

Note: The top two or three factors in each column are bold.

actual status and condition of a project than owners do. For instance, they know exactly about subsurface investigate results of a project and all required resources to complete its foundation. This information advantage enables contractors to develop a profitable quote and negotiation plans to owners. If these plans were implemented, contractors can realize their profits and strengthen calculative trust with owners, eventually facilitating a project's success. However, owners have disadvantaged information about the real situation of a project and hardly develop calculative trust without seeing deliverables, so they have less belief in calculative trust toward a project's success. This result also was also supported by a previous study that suggested contractors should be the candidate to initiate trust through competent performance and maintaining effective communication with owners. So the trust can expand with reciprocal trustworthiness in the long term (Wong et al. 2005).

3. Mediating effects

The role of mediating variables for owners and contractors is slightly different. In the owner's responses, two mediating variables—calculative trust (0.168) and relational trust (0.537)—contribute directly to project success. This suggests that relational trust is almost three times as important as calculative trust for project success. In the contractor's response, relational trust leads directly to project success (0.576), but the impact of calculative trust splits into two paths: one goes straight to project success (0.267), while the other detours to relational trust then to project success (0.232). This finding implies that contractors' perceptions of trust are more complex than those of owners because of the multiple influences and interactions involved in developing trust. For instance, contractors build trust, confidence, and other factors into the joint risk management in dealing with potential risks in relational partnerships, and such relationships could reversely influence their perception of trust (Doloi 2009).

### Contract and Relational Trust

The results show that a project contract has a positive impact on relational trust, with the coefficients of paths being 0.242 for contractors' responses and 0.410 for owners' responses. This result conflicts with the null hypothesis, which assumes that a complete contract would lower the relational trust (Herold 2010; Lyons and Mehta 1997). Several reasons could possibly explain this unexpected result, as follows.

The previous literature only studied the null hypothesis in theoretical and conceptual models and did not test it empirically. This study conducted a questionnaire survey of hundreds of professionals working in the frontlines of the Chinese construction industry. The conclusion is based on the real understanding of practitioners and could be new evidence to complement the theoretical development.

The nature of the construction industry could also contribute to this unexpected result. The variety of construction projects makes every contract different. Meanwhile, due to the uncertainty of construction projects, unexpected issues often happen in the construction process no matter how precisely a contract is written. There does not exist a true "complete contract" with the capacity to address all issues in the construction industry in practice. This lack of a complete contract, nevertheless, creates room for mutual trust, with either positive or negative impacts, for both parties (Williamson 1993). Resolving change orders and conflicts of interest in the construction process are typically seen as negative signs with regard to the relationship and could make both parties hostile to each other, and therefore damage relational trust. For instance, in a circumstance in which a contract does not specify an owner's payment schedule, if the contractor asks the owner to pay for a key milestone and gets the payment, the contractor would think they deserve it and the relational trust will not be changed; however, if the owner refuses to pay, the relational trust could be damaged. This is a case in which an incomplete contract could worsen the mutual relationship; in contrast, a complete contract can foster a positive collaborative relationship during the construction process.

### Relationship between Calculative Trust and Relational Trust

Past studies have shown that calculative trust and relational trust are linked (Lewicki and Bunker 1994), but they have not shown the linked relationship using quantitative measures. This study further

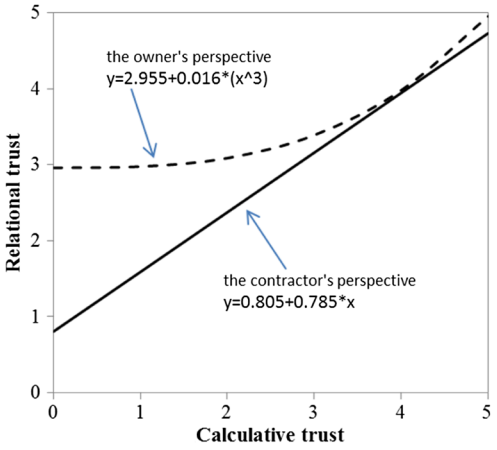


**Fig. 4.** Relationship between relational trust and calculative trust

quantifies such a relationship and discusses the distinct findings based on owners' and contractors' responses.

For the contractors' sample, the relationship between calculative trust and relational trust is shown as a linear correlation. By using linear regression analysis, the relationship is presented as follows, with a high significance level

$$\text{Relative trust} = 0.805 + 0.785 \times \text{Calculative trust}$$
$$(R = 0.656, F = 218.044, t = 14.766, \text{Sig.} = 0.000) \quad (1)$$

In the owners' sample, the SEM results show that calculative trust and relational trust are related, but not in a linear correlation, so this study used a quadratic function to explore their relationship, which is assumed as follows:

$$\text{Relative trust} = \beta_0 + \beta_1 \times \text{calculative trust} + \beta_2 \times \text{calculative trust}^2 + \beta_3 \times \text{calculative trust}^3 \quad (2)$$

After multiple trial-and-error attempts at regression modeling by using the statistical software package *SPSS*, the study found that the following equation was the best fit for the model

$$\text{Relative trust} = 2.955 + 0.016 \times \text{Calculative trust}^3$$
$$(R = 0.554, F = 130.81, \text{Sig.} = 0.000) \quad (3)$$

The regression results for both owners and contractors are shown in Fig. 4. Both relationships share a common feature in which only high calculative trust can yield relational trust. For instance, when the calculative trust was 5, the highest level in this study, the relational trust was 5 and 4.955 for owners and contractors, respectively. In a practical sense, higher levels of both types of trust indicate that both parties would like to develop a long-term strategic partnership.

While both curves show some similarities with regard to the high level of trust, they also demonstrate various differences. For the contractors' sample, relational trust keeps a constant high correlation with calculative trust, with a coefficient of 0.785. The reason could be that contractors aim to complete a project and to earn a profit from it. Therefore, calculative trust becomes the essential part of a firm's vision and maintains a high level of influence on relational trust.

For the owners' sample, when calculative trust is low, the two types of trust are less closely related. Only when calculative trust achieves a certain high level does relational trust start increasing accordingly and begin to link with the calculative trust. Meanwhile, relative trust always maintains a higher level (2.955) no matter what the calculative trust level is. This is possibly because an owner assigns a project to a contractor based on the first impression made by the contractor and its promise to complete the project—without seeing any accomplished project yet. Such a business decision, sometimes involving projects costing millions of dollars, is a strong way of showing trust in relational feelings. Such a level of relational trust will not be easily changed until the calculative trust reaches a certain high level during the project implementation process. In practice, owners would like to develop a strategic partnership with contractors when both types of trust are high.

## Conclusion and Practical Implications

This study investigates how different types of trust affect project success in the construction industry from the perspectives of both owners and contractors. The SEM models have been established to interpret these effects based on a literature review, the characteristics of the construction industry, and a large-scale questionnaire survey. The model was tested by two rounds of questionnaire surveys, collecting 57 pilot respondents and 697 final respondents from Chinese construction professionals. The results show that six antecedents of trust—reputation, competence, integrity, communication, reciprocity, and the contract—are valid factors for establishing the trust between owners and contractors. To achieve project success, the top factors of concern to owners are integrity and communication, while the top factors of concern to contractors are communication and competence. These factors fully impact project success through the mediating variables of calculative trust and relational trust.

The conclusion of this research complements the existing knowledge in three aspects.

First, it identifies and differentiates influential mechanisms of trust antecedents for both owners and contractors. Owners and contractors share similar reasons for developing relational trust, including integrity and communication, but they show differing preferences with regard to calculative trust. Owners favor mutual reciprocity, the project contract, and the contractor's integrity, while contractors prefer mutual communication and owners' competence.

Second, it explores the dynamic relationship between calculative trust and relational trust and explains how they contribute to the success of the project. For both parties, relational trust generates a higher impact on project success than does calculative trust. In the contractors' sample, relational trust keeps the positive linear relationship with calculative trust, while in the owners' sample, relational trust maintains a medium-to-high level and only increases when calculative trust reaches a high degree. Such different paths are similar to, yet improved on, the previous research on the linkage of "trust-owner/contractor relationship-project success" (Pinto et al. 2009).

Third, it proposes a newly found relationship between the project contract and relational trust in the construction industry. The more complete a project contract is, the stronger the relational trust. This conclusion conflicts with the existing literature, but it can be explained by the unique nature of the construction industry.

The study can also help construction practitioners, including both owners and contractors, to understand and appreciate the antecedents of trust in the construction industry and to help them design specific strategies to effectively cultivate the trust by focusing on the highlighted types of behavior to improve the chances of project success. Globally, as China becomes the largest construction market in the world, many foreign contractors flooded in China's

construction market for business. By understanding, trust can help foreign stakeholders cultivate positive working relations in China. Meanwhile, China also becomes one of the largest countries exporting construction services globally. So understanding the perspective of trust in China's contractors can also help global owners better position and strategize themselves when working with China's contractors.

For owners, to secure contractors' trust, they can be more transparent in disclosing their financial performance, especially payment history for past projects, to clear contractors' doubt. They also need effective briefing skills and to clearly communicate their requirements, policies, and regulations to potential contractors in pursuance of their calculative trust. During the construction period, owners need to perform consistently to their promises and comply with the agreed contract terms, such as on-time progress payment, so as to enhance the relative trust from contractors.

For contractors to gain trust from owners, they need to behave strictly as promised from the initial engagement of a potential business, since the owners will observe their behaviors and determine the degree of relative trust from the observation. Contractors also need extra efforts in communicating and developing a fair contract that can dissolve the concern from owners who may assume themselves at a disadvantage for construction activities. When owners regard themselves as possessing asymmetric information (such as project actual cost and schedule data), they appreciate the forgiveness from contractors. So, the other strategy for contractors is to be flexible and considerate for an owner's request when a surprise happens. This can quickly establish owner's reciprocity and their calculative trust. Owners and contractors can both benefit from this study by measuring the other party's trust levels and making customized efforts to foster trust in their business partners. Governmental administrative agencies can also use the conclusions of this study as a governing policy reference to administering the construction industry toward a trustful, fair, and healthy environment.

However, the study has several limitations that could be further investigated in the future. First, this study used two sets of surveys to measure the different perspectives from both owners and contractors, but owners and contractors are not paired, and their perspectives may not be explicitly matched. A future study can use the paired study to explore the mutual relationship between owners and contractors in a project. Second, this study investigated trust from a retrospective approach but did not consider the dynamic process of the trust establishment. The trust between owners and contractors may constantly change during the execution of a project. Such a dynamic evolution and transformation process are also worth a future study. Third, other disciplines and theories, for instance, behavioral economics and game theory, can be further utilized to explain fundamental rationales and mechanisms behind the observations identified in this study.

## Supplemental Data

Tables S1–S3 are available online in the ASCE Library (www.ascelibrary.org).

## References


Achrol, R. S. (1997). "Changes in the theory of interorganizational relations in marketing: Toward a network paradigm." *J. Acad. Marketing Sci.*, 25(1), 56–71.

Andreoni, J. (1995). "Cooperation in public-goods experiments: Kindness or confusion?" *Am. Econ. Rev.*, 85(4), 891–904.

Anvuur, A. M., and Kumaraswamy, M. M. (2007). "Conceptual model of partnering and alliancing." *J. Constr. Eng. Manage.*, 10.1061/(ASCE)0733-9364(2007)133:3(225), 225–234.

Badenfelt, U. (2010). "I trust you, I trust you not: A longitudinal study of control mechanisms in incentive contracts." *Constr. Manage. Econ.*, 28(3), 301–310.

Bagozzi, R. P., and Yi, Y. (1988). "On the evaluation of structural equation models." *J. Acad. Marketing Sci.*, 16(1), 74–94.

Barney, J. B., and Hansen, M. H. (1994). "Trustworthiness as a source of competitive advantage." *Strategic Manage. J.*, 15, 175–190.

Bennett, R., and Gabriel, H. (2001). "Reputation, trust and supplier commitment: the case of shipping company/seaport relations." *J. Bus. Ind. marketing*, 16(6), 424–438.

Bollen, K. A. (1989). "A new incremental fit index for general structural equation models." *Sociol. Methods Res.*, 17(3), 303–316.

Booth, B. E. (1998). "Processes and the evolution of trust in interfirm collaborative relationships: A longitudinal study." Northwestern Univ., Evanston, IL.

Bresnen, M., and Marshall, N. (2000). "Building partnerships: case studies of client-contractor collaboration in the U.K. construction industry." *Constr. Manage. Econ.*, 18(7), 819–832.

Butler, R., and Gill, J. (1995). "Learning and knowledge in joint ventures: The importance of trust." *Proc., British Academy of Management Annual Conf.*, British Academy of Management, London.

Buvik, M. P., and Rolfsen, M. (2015). "Prior ties and trust development in project teams—A case study from the construction industry." *Int. J. Project Manage.*, 33(7), 1484–1494.

Cheng, E. W., and Li, H. (2002). "Construction partnering process and associated critical success factors: Quantitative investigation." *J. Manage. Eng.*, 10.1061/(ASCE)0742-597X(2002)18:4(194), 194–202.

Cheng, E. W., and Li, H. (2004). "Contractor selection using the analytic network process." *Constr. Manage. Econ.*, 22(10), 1021–1032.

Cheung, S. O., Chow, P. T., and Wong, P. S. P. (2014). "Trusting behaviours in construction contracting." *Construction dispute research*, Springer, Berlin, 111–121.

Cheung, S. O., Yiu, T. W., and Lam, M. C. (2013). "Interweaving trust and communication with project performance." *J. Constr. Eng. Manage.*, 10.1061/(ASCE)CO.1943-7862.0000681, 941–950.

Child, J., and Möllering, G. (2003). "Contextual confidence and active trust development in the Chinese business environment." *Organiz. Sci.*, 14(1), 69–80.

Chiles, T. H., and McMackin, J. F. (1996). "Integrating variable risk preferences, trust, and transaction cost economics." *Acad. Manage. Rev.*, 21(1), 73–99.

Chou, J.-S., and Ngo, N.-T. (2014). "Identifying critical project management techniques and skills for construction professionals to achieving project success." *Proc., Industrial Engineering and Engineering Management (IEEM), 2014 IEEE Int. Conf.*, IEEE, New York, 1204–1208.

Chow, P. T., Cheung, S. O., and Chan, K. Y. (2012). "Trust-building in construction contracting: Mechanism and expectation." *Int. J. Project Manage.*, 30(8), 927–937.

Coleman, J. S. (1988). "Social capital in the creation of human capital." *Am. J. Sociol.*, 94(1), S95–S120.

Cook, J., and Wall, T. (1980). "New work attitude measures of trust, organizational commitment and personal need non-fulfilment." *J. Occup. Psychol.*, 53(1), 39–52.

Creed, W. D., and Miles, R. E. (1996). "Trust in organizations." *Trust in organizations: Frontiers of theory and research*, Sage, Thousand Oaks, CA, 16–38.

Cronbach, L. J. (1951). "Coefficient alpha and the internal structure of tests." *Psychometrika*, 16(3), 297–334.

Cummings, L. L., and Bromiley, P. (1996). "The organizational trust inventory (OTI)." *Trust Organiz.: Front. Theory Res.*, 302, 330.

Deutsch, M. (1958). "Trust and suspicion." *J. Conflict Resol.*, 2(4), 265–279.

Diallo, A., and Thuillier, D. (2005). "The success of international development projects, trust and communication: An African perspective." *Int. J. Project Manage.*, 23(3), 237–252.

Doloi, H. (2009). "Relational partnerships: The importance of communication, trust and confidence and joint risk management in achieving project success." *Constr. Manage. Econ.*, 27(11), 1099–1109.

Doney, P. M., and Cannon, J. P. (1997). "An examination of the nature of trust in buyer-seller relationships." *J. Marketing*, 61(2), 35–51.

Dvir, D., Sadeh, A., and Malach-Pines, A. (2006). "Projects and project managers: The relationship between project managers' personality, project types, and project success." *Project Manage. Q.*, 37(5), 36.
Egan, J. (1998). "Rethinking construction." Dept. of Environment, HMSO, London.
Fornell, C., and Larcker, D. F. (1981). "Evaluating structural equation models with unobservable variables and measurement error." *J. Marketing Res.*, 18(1), 39–50.
Fukuyama, F. (1995). *Trust: The social virtues and the creation of prosperity*, Free Press, New York.
Gambetta, D. (1988). *Trust: Making and breaking cooperative relations*, Blackwell, London.
Gneezy, U., Güth, W., and Verboven, F. (2000). "Presents or investments? An experimental analysis." *J. Econ. Psychol.*, 21(5), 481–493.
Gulati, R. (1995). "Does familiarity breed trust? The implications of repeated ties for contractual choice in alliances." *Acad. Manage. J.*, 38(1), 85–112.
Hair, J., Jr., Anderson, R., Tatham, R., and Black, W. (1995). *Multivariate data analysis*, 4th Ed., Prentice Hall, Englewood Cliffs, NJ.
Hair, J. F., Black, W. C., Babin, B. J., and Anderson, R. E. (2010). *Multivariate data analysis*, 7th Ed., Prentice Hall, Englewood Cliffs, NJ.
Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., and Tatham, R. L. (2006). *Multivariate data analysis*, Pearson Prentice Hall, Upper Saddle River, NJ.
Handfield, R. B., and Bechtel, C. (2002). "The role of trust and relationship structure in improving supply chain responsiveness." *Ind. Marketing Manage.*, 31(4), 367–382.
Handy, C. (1995). "Trust and the virtual organization." *Harvard Bus. Rev.*, 73(3), 132–142.
Hartman, F. (2000). "The role of trust in project management." *Proc., PMI Research Conf. 2000: PM Research at the Turn of the Millennium*, Project Management Institute, PA, 23–28.
Hatch, M. J., and Schultz, M. (1997). "Relations between organizational culture, identity and image." *Eur. J. Marketing*, 31(5/6), 356–365.
Hatush, Z., and Skitmore, M. (1997). "Criteria for contractor selection." *Constr. Manage. Econ.*, 15(1), 19–38.
Hatush, Z., and Skitmore, M. (1998). "Contractor selection using multicriteria utility theory: An additive model." *Build. Environ.*, 33(2-3), 105–115.
Herold, F. (2010). "Contractual incompleteness as a signal of trust." *Games Econ. Behav.*, 68(1), 180–191.
Hovland, C. I., Janis, I. L., and Kelley, H. H. (1953). *Communication and persuasion; psychological studies of opinion change*, Yale University Press, New Haven, CT.
Hovland, C. I., and Weiss, W. (1951). "The influence of source credibility on communication effectiveness." *Public Opinion Q.*, 15(4), 635–650.
Iyer, K., and Jha, K. (2006). "Critical factors affecting schedule performance: Evidence from Indian construction projects." *J. Constr. Eng. Manage.*, 10.1061/(ASCE)0733-9364(2006)132:8(871), 871–881.
Jaafari, A. (2003). "Project management in the age of complexity and change." *Project Manage. J.*, 34(4), 47–58.
Jannadia, M. O., Assaf, S., Bubshait, A., and Naji, A. (2000). "Contractual methods for dispute avoidance and resolution (DAR)." *Int. J. Project Manage.*, 18(1), 41–49.
Jofre-Bonet, M., and Pesendorfer, M. (2000). "Bidding behavior in a repeated procurement auction: A summary." *Eur. Econ. Rev.*, 44(4), 1006–1020.
Kadefors, A. (2004). "Trust in project relationships—Inside the black box." *Int. J. Project Manage.*, 22(3), 175–182.
Karlsen, J. T. (2008). "Forming relationships with stakeholders in engineering projects." *Eur. J. Ind. Eng.*, 2(1), 35–49.
Karlsen, J. T., Graee, K., and Massaoud, M. J. (2008). "Building trust in project-stakeholder relationships." *Baltic J. Manage.*, 3(1), 7–22.
Ke, H., Cui, Z., Govindan, K., and Zavadskas, E. K. (2015). "The impact of contractual governance and trust on EPC projects in construction supply chain performance." *Eng. Econ.*, 26(4), 349–363.
Khalfan, M. M., McDermott, P., and Swan, W. (2007). "Building trust in construction projects." *Supply Chain Manage.: Int. J.*, 12(6), 385–391.
Kim, J.-O., and Mueller, C. W. (1978). *Factor analysis: Statistical methods and practical issues*, Sage, Beverly Hills, CA.
Kline, R. B. (2011). *Principles and practice of structural equation modeling*, Guilford Press, New York.
Koufteros, X. A. (1999). "Testing a model of pull production: A paradigm for manufacturing research using structural equation modeling." *J. Oper. Manage.*, 17(4), 467–488.
Latham, M. (1994). "Constructing the team: Joint review of procurement and contractual arrangements in the United Kingdom construction industry: Final report." HM Stationery Office, London.
Lau, E., and Rowlinson, S. (2009). "Interpersonal trust and inter-firm trust in construction projects." *Constr. Manage. Econ.*, 27(6), 539–554.
Lewicki, R. J., and Bunker, B. B. (1994). "Trust in relationships: A model of trust development and decline." Max M. Fisher College of Business, Ohio State Univ., OH.
Lewis, J. D., and Weigert, A. (1985). "Trust as a social reality." *Social Forces*, 63(4), 967–985.
Lim, E. H., and Ling, F. Y. Y. (2002). "Model for predicting clients' contribution to project success." *Eng. Constr. Archit. Manage.*, 9(5-6), 388–395.
Lin, L. (2002). "A project task coordination model for team organization in concurrent engineering." *Concurrent Eng.*, 10(3), 187–203.
*LISREL version 8.50* [Computer software]. Scientific Software, Chicago.
Lowe, D. J., and Parvar, J. (2004). "A logistic regression approach to modelling the contractor's decision to bid." *Constr. Manage. Econ.*, 22(6), 643–653.
Lu, C.-S., Lai, K.-H., and Cheng, T. E. (2007). "Application of structural equation modeling to evaluate the intention of shippers to use Internet services in liner shipping." *Eur. J. Oper. Res.*, 180(2), 845–867.
Lyons, B., and Mehta, J. (1997). "Contracts, opportunism and trust: Self-interest and social orientation." *Cambridge J. Econ.*, 21(2), 239–257.
Mahdi, I. M., Riley, M. J., Fereig, S. M., and Alex, A. P. (2002). " A multi-criteria approach to contractor selection." *Eng. Constr. Archit. Manage.*, 9(1), 29–37.
Malhotra, D. (2004). "Trust and reciprocity decisions: The differing perspectives of trustors and trusted parties." *Organiz. Behav. Human Decis. Process.*, 94(2), 61–73.
Massa, M., and Simonov, A. (2003). "Reputation and interdealer trading: A microstructure analysis of the treasury bond market." *J. Financial Markets*, 6(2), 99–141.
Mayer, R. C., Davis, J. H., and Schoorman, F. D. (1995). "An integrative model of organizational trust." *Acad. Manage. Rev.*, 20(3), 709–734.
McAllister, D. J. (1995). "Affect-and cognition-based trust as foundations for interpersonal cooperation in organizations." *Acad. Manage. J.*, 38(1), 24–59.
McDermott, P., Khalfan, M., and Swan, W. (2005). "Trust in construction projects." *J. Financial Manage. Property Constr.*, 10(1), 19–32.
McDermott, P., Khalfan, M. M., and Swan, W. (2004). "An exploration of the relationship between trust and collaborative working in the construction sector." *Constr. Inform. Q.*, 6(4), 140–146.
Medsker, G. J., Williams, L. J., and Holahan, P. J. (1994). "A review of current practices for evaluating causal models in organizational behavior and human resources management research." *J. Manage.*, 20(2), 439–464.
Meng, X. (2012). "The effect of relationship management on project performance in construction." *Int. J. Project Manage.*, 30(2), 188–198.
Meredith, J. R., and Mantel, S. J., Jr. (2011). *Project management: A managerial approach*, Wiley, New York.
Molenaar, K., Washington, S., and Diekmann, J. (2000). "Structural equation model of construction contract dispute potential." *J. Constr. Eng. Manage.*, 10.1061/(ASCE)0733-9364(2000)126:4(268), 268–277.
Moorman, C., Zaltman, G., and Deshpande, R. (1992). "Relationships between providers and users of market research: The dynamics of trust." *J. Marketing Res.*, 29(3), 314–328.
Nunnally, J. (1978). *Psychometric theory*, McGraw-Hill, New York.
Palaneeswaran, E., and Kumaraswamy, M. M. (2000). "Contractor selection for design/build projects." *J. Constr. Eng. Manage.*, 126(5), 331–339.
Papke-Shields, K. E., Beise, C., and Quan, J. (2010). "Do project managers practice what they preach, and does it matter to project success?" *Int. J. Project Manage.*, 28(7), 650–662.

Peng, S. (1999). "The establishment of trust: Relational and regulational approaches (in Chinese)." *Sociol. Stud.*, 2(2), 53–66.
Pinto, J. K., and Slevin, D. P. (1987). "Critical factors in successful project implementation." *Engineering Management, IEEE Transactions on Engineer*, Vol. 1, 22–27.
Pinto, J. K., Slevin, D. P., and English, B. (2009). "Trust in projects: An empirical assessment of owner/contractor relationships." *Int. J. Project Manage.*, 27(6), 638–648.
Pruitt, D. G., and Kimmel, M. J. (1977). "Twenty years of experimental gaming: Critique, synthesis, and suggestions for the future." *Ann. Rev. Psychol.*, 28(1), 363–392.
Quddus, M., Goldsby, M., and Farooque, M. (2000). "Trust: The social virtues and the creation of prosperity—A review article." *Eastern Econ. J.*, 26(1), 87–98.
Redding, S. G. (1990). *The spirit of Chinese capitalism*, Walter de Gruyter, Berlin.
Rousseau, D. M., Sitkin, S. B., Burt, R. S., and Camerer, C. (1998). "Not so different after all: A cross-discipline view of trust." *Acad. Manage. Rev.*, 23(3), 393–404.
Sako, M. (1992). *Price, quality and trust: Inter-firm relations in Britain and Japan*, Cambridge University Press, Cambridge, U.K.
Shapiro, D. L., Sheppard, B. H., and Cheraskin, L. (1992). "Business on a handshake." *Negotiation J.*, 8(4), 365–377.
Shaw, R. B. (1997). *Trust in the balance: Building successful organizations on results, integrity, and concern*, Jossey-Bass, San Francisco.
Shenhar, A. J., Dvir, D., Levy, O., and Maltz, A. C. (2001). "Project success: A multidimensional strategic concept." *Long Range Plann.*, 34(6), 699–725.
Singh, D., and Tiong, R. L. (2005). "A fuzzy decision framework for contractor selection." *J. Constr. Eng. Manage.*, 131(1), 62–70.
Singh, D., and Tiong, R. L. (2006). "Contractor selection criteria: Investigation of opinions of Singapore construction practitioners." *J. Constr. Eng. Manage.*, 132(9), 998–1008.
Smith, K. G., Carroll, S. J., and Ashford, S. J. (1995). "Intra- and interorganizational cooperation: Toward a research agenda." *Acad. Manage. J.*, 38(1), 7–23.
Snijders, C., and Keren, G. (1999). "Determinants of trust." *Games and human behavior: Essays in honor of Amnon Rapoport*, D. V. Budescu, I. Erev, and R. Zwick, eds., Lawrence Erlbaum, Mahwah, NJ, 355–383.
Soetanto, R., and Proverbs, D. G. (2002). "Modelling the satisfaction of contractors: The impact of client performance." *Eng. Constr. Archit. Manage.*, 9(5-6), 453–465.
*SPSS* [Computer software]. IBM, Armonk, NY.
Steiger, J. H. (1990). "Structural model evaluation and modification: An interval estimation approach." *Multivariate Behav. Res.*, 25(2), 173–180.
Swan, J., Scarbrough, H., and Robertson, M. (2002). "The construction of communities of practice in the management of innovation." *Manage. Learn.*, 33(4), 477–496.
Tabish, S., and Jha, K. N. (2011). "Identification and evaluation of success factors for public construction projects." *Constr. Manage. Econ.*, 29(8), 809–823.
Thompson, I., Cox, A., and Anderson, L. (1998). "Contracting strategies for the project environment." *Eur. J. Purchasing Supply Manage.*, 4(1), 31–41.
Tinsley, H. E. A., and Tinsley, D. J. (1987). "Uses of factor analysis in counseling psychology research." *J. Counseling Res.*, 34(4), 411–424.
Uzzi, B. (1997). "Social structure and competition in interfirm networks: The paradox of embeddedness." *Administrative Sci. Q.*, 42(1), 35–67.
Whitley, R. D. (1991). "The social construction of business systems in East Asia." *Organiz. Stud.*, 12(1), 1–28.
Williamson, O. E. (1975). *Markets and hierarchies*, Free Press, New York, 26–30.
Williamson, O. E. (1993). "Calculativeness, trust, and economic organization." *J. Law Econ.*, 36(1), 453–486.
Wilson, D. T. (1995). "An integrated model of buyer-seller relationships." *J. Acad. Marketing Sci.*, 23(4), 335–345.
Wong, E. S., Then, D., and Skitmore, M. (2000). "Antecedents of trust in intra-organizational relationships within three Singapore public sector construction project management agencies." *Constr. Manage. Econ.*, 18(7), 797–806.
Wong, P. S., Cheung, S. O., and Ho, P. K. (2005). "Contractor as trust initiator in construction partnering—Prisoner's dilemma perspective." *J. Constr. Eng. Manage.*, 10.1061/(ASCE)0733-9364(2005)131:10(1045), 1045–1053.
Wong, P. S. P., and Cheung, S. O. (2005). "Structural equation model of trust and partnering success." *J. Manage. Eng.*, 10.1061/(ASCE)0742-597X(2005)21:2(70), 70–80.
Wong, P. S.-P., and Cheung, S.-O. (2004). "Trust in construction partnering: Views from parties of the partnering dance." *Int. J. Project Manage.*, 22(6), 437–446.
Wong, W. K., Cheung, S. O., Yiu, T. W., and Pang, H. Y. (2008). "A framework for trust in construction contracting." *Int. J. Project Manage.*, 26(8), 821–829.
Wood, G., and McDermott, P. (1999). "Searching for trust in the UK construction industry: An interim view." *Profitable partnering in construction procurement*, E&FN Spon, 107–116.
Wood, G., McDermott, P., and Swan, W. (2002). "The ethical benefits of trust-based partnering: The example of the construction industry." *Bus. Ethics: Eur. Rev.*, 11(1), 4–13.
Yang, K. (2006). "Trust and citizen involvement decisions trust in citizens, trust in institutions, and propensity to trust." *Administration Soc.*, 38(5), 573–595.
Yang, L.-R., Chen, J.-H., and Wang, H.-W. (2012). "Assessing impacts of information technology on project success through knowledge management practice." *Autom. Constr.*, 22, 182–191.
Yean Yng Ling, F., and Bao Tram Tran, H. (2012). "Ingredients to engender trust in construction project teams in Vietnam." *Constr. Innovation*, 12(1), 43–61.
Zaghloul, R., and Hartman, F. (2003). "Construction contracts: The cost of mistrust." *Int. J. Project Manage.*, 21(6), 419–424.
Zaheer, A., McEvily, B., and Perrone, V. (1998). "Does trust matter? Exploring the effects of interorganizational and interpersonal trust on performance." *Organiz. Sci.*, 9(2), 141–159.
Zou, P. X., and Sunindijo, R. Y. (2013). "Skills for managing safety risk, implementing safety task, and developing positive safety climate in construction project." *Autom. Constr.*, 34, 92–100.