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Risk perception and propensity in bid/no-bid decision-making of construction projects

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Abstract
Purpose – Making the right bid/no-bid decision is critical to the success and development of construction contracting enterprises. Decision makers' personal characteristics, such as risk perception and propensity, have great impact on bid/no-bid decisions, which is the major concern of this research. The purpose of this paper is to explore the relationship among decision makers' risk perception, risk propensity, and their bid/no-bid decision making of construction projects, as well as the factors influencing the risk perception and propensity.

Design/methodology/approach – In total, four hypotheses were proposed based on an extensive literature review. Experimental questionnaires were distributed to employees working in Chinese construction contracting enterprises with knowledge of construction bidding, and 134 valid questionnaires were obtained. Multivariate statistical analysis through SPSS 19.0 was used to analyze the acquired data.

Findings – Data analysis shows that in the context of international construction contracting: risk perception has a negative influence on bid/no-bid decision making; while risk propensity produces a positive influence and the probability and magnitude of potential gain or loss both have significant impacts on risk perception, and the probability plays a more important role.

Originality/value – This research studied the bid/no-bid decision making of construction projects from the new perspectives of risk perception and risk propensity of the decision makers.

Keywords Risk perception, Construction management, Risk, Bid/no-bid, Experimental questionnaire, Risk propensity

Paper type Research paper

1. Introduction

Globalization has created and provided opportunities for contracting enterprises to expand into the international construction contracting market (Oo et al., 2007). Bidding decision for international construction projects is becoming difficult due to the uncertainties and complexities within the special environment (Han et al., 2005). Chinese international project contracting is increasing at a rapid speed in recent years, but there also exist decision problems of international projects made by contractors. The development of successful bidding strategies is considered as a key factor to the
success of contracting enterprises (Lin and Chen, 2004). March and Simon (1958) stated that the way in which people in organizations make decisions and solve problems are critical in understanding organizational behaviors. Therefore, this research focuses on the individual decision making and analyzes the risk perception and propensity affecting a bidding decision. The bidding decision includes bid/no-bid (Wanous et al., 2003; Lin and Chen, 2004) and the bid price (Cheng et al., 2011; Oo et al., 2012). This research focuses on the Chinese contractors’ bid/no-bid decision making of international construction projects.

In order to help decision makers make better bid/no-bid strategies in uncertain environment, various methods have been developed and those methods can be broadly categorized into: scoring methods, multi-attributes decision making, analytic hierarchy process (AHP) method, and fuzzy set approaches (Lin and Chen, 2004). For example, AHP, developed by Saaty (1980, 1986), is identified and widely accepted as an important approach to multi-criteria decision-making problems of choice (Lai et al., 2002). Unfortunately, the method of AHP is unwieldy used in practice due to its complicated process to acquire consistent assessment (Cheng et al., 2011). Quantitative studies about risk decision making (e.g. mathematical programming, economic models) rarely focused on the characteristics or behaviors of decision makers, which have both practical and theoretical limitations (Lin and Chen, 2004). However, bidding decisions rely heavily on intuition, experience, guesswork, and risk attitude of decision makers due to the complexity and hard-to-define nature of bidding (Cheng et al., 2011). In practice, bid decisions are usually associated with subjective considerations. Therefore, from a behavioral perspective, it is necessary to incorporate behavioral factors into bidding decisions.

Bidding decision is a complex and highly unstructured process, characterized with uncertainty and subjectivity. Even though many factors affect decision-making behaviors, risk perception, and risk propensity may be the two key factors which play central roles in risk decision making (Sitkin and Pablo, 1992; Keil et al., 2000; Chan and Maria, 2007; Giunipero et al., 2008). Managers who have accurate perceptions of risk and assess risk effectively will make wiser decisions and achieve more successful outcomes (McComb and Smith, 1991). However, little research has been conducted in the construction domain, except for Han et al. (2005), who conducted experiments to investigate the risk attitude and bid decision behavior in the selection of international construction projects. It is therefore necessary to conduct research into the bid/no-bid decision making on these two factors.

Risk perception, defined as “a decision-maker’s assessment of the risk inherent in a situation” (Sitkin and Pablo, 1992), is mainly influenced by both the probability and magnitude of potential gain or loss (Dunegan et al., 1992; Mellers and Chang, 1994; Keil et al., 2000). Risk propensity refers to the notion that “a decision-maker has a consistent tendency to either take or avoid actions that he or she has judged to be risky” (Harnett and Cummings, 1980; Sitkin and Pablo, 1992). Some researchers found out that outcome history could impact risk propensity and indirectly determine the riskiness of strategic decisions (Bowman, 1982; Sitkin and Pablo, 1992). Therefore, the objectives of this research are to study: the relationship between risk perception, risk propensity, and bid/no-bid decision making; the influence of probability and magnitude of potential gain or loss on the risk perception of decision makers; and the influence of outcome history on the decision makers’ risk propensity. To address these problems, an experimental questionnaire was conducted in the setting of bidding of international construction projects. Data were collected from employees in Chinese construction industry, who were asked to play a role of bid/no-bid decision maker in the experiment.
2. Literature review
Sitkin and Pablo (1992) proposed an integrated conceptual model of the determinants of risk behavior, placing risk propensity and risk perceptions in a central role. This model is based on three clusters of factors influencing individual’s risk decision making, namely characteristics of the individual decision maker, characteristics of the organizational context, and characteristics of the problem itself. Concerning this conceptual model, Sitkin and Weingart (1995) tested part of it, examining the mediating role of risk propensity and risk perception on the effects of problem framing and outcome history on risky decision making. Then Keil et al. (2000) studied the interrelationships that exist among risk perception, risk propensity, and decision about whether or not to continue a project. Based on the literature, this research aims to propose a model related to the bid/no-bid decision-making context.

2.1 Outcome history and risk propensity
Outcome history, a person-situation interaction characteristic, is defined as the degree to which the decision makers believed that previous risk-related decisions have resulted in successful or unsuccessful outcomes (Sitkin and Weingart, 1995; Allen et al., 2007). In this research, successful outcome history means that the contractors make successful and appropriate bid/no-bid decision making of international projects. While unsuccessful or failed outcome history means that the contractors make inappropriate bid/no-bid decisions which causes the project’s failure. If the outcome history is successful, the decision maker would be risk taking in the future decision making (Osborn and Jackson, 1988; Thaler and Johnson, 1990; Byrne, 2005). However, this has not been studied in the context of bid/no-bid decision making of construction projects. This research will investigate the relationship between outcome history and risk propensity in this certain context. Therefore, the first hypothesis is proposed as follows:

\[ H1. \] The outcome history of decision makers has a significant influence on their risk propensity.

2.2 Magnitude or probability of potential gain or loss and risk perception
Risk is conceptualized as a function of probability and magnitude or regarded as the combination of the probability of desirable events and the magnitude of loss associated with such events (Douglas, 1990; Miller and Leiblein, 1996; McNamara and Bromiley, 1999; Bye and Lamvik, 2007). Based on the definition of risk, both probability and magnitude are important to the overall perceptions of risk (Keil et al., 2000; Ellis et al., 2010). People’s risk perception is based more on risk magnitude than on probability, meaning that the magnitude of potential loss is a more influential factor in shaping risk perception (March and Shapira, 1987; Keil et al., 2000; Reynolds and Nelson, 2007). But in some special cases, probability might play a more vital role in shaping risk perception than magnitude of loss (Bontempo et al., 1997). Therefore, this research will test the relationship between the magnitude or probability of potential gain or loss and risk perception in this specific context. Thus, the second hypothesis is as follows:

\[ H2. \] The magnitude of potential gain or loss has more impact on risk perception than probability.
2.3 Risk perception and decision making
As an inherent part of the decision-making process, risk perception can be understood as an individual's assessment of risk (Williamsa and Noyes, 2007). Therefore, it is logical and reasonable to assume that an individual's perception of risk is likely to affect the decision-making process (Blais and Weber, 2001; Rundmo, 2001; de Campriieu et al., 2007; Reynolds and Nelson, 2007). Meanwhile, researchers generally agreed that there is a relationship between risk perception and decision making (Krueger and Dickson, 1994; Keil et al., 2000, Hillson and Murray-Webster, 2004; Williamsa and Noyes, 2007). However, some of the relationships identified are not consistent in previous studies. Some researchers observed that as the level of perceived risk increased, a person is less likely to involve in risk-taking behavior (March and Shapira, 1987; Dunegan et al., 1992). While some others thought that a person who perceived high risk tended to be risk taking (Kahneman and Tversky, 1979). The contradiction reveals the need of analyzing the influence of the risk perception on decision making in the international construction contracting context. The following is the third hypothesis:

H3a. There is a significant negative relationship between risk perception and bid/no-bid decision making. Higher risk perception indicates less chance of the decision makers to bid high-risk projects; lower perceived risk means that the decision makers are more likely to bid high-risk projects.

2.4 Risk propensity and decision making
Risk propensity is defined as a trait characterized by an increasing probability of engaging in behaviors that provide potential danger and opportunity for some benefit (Botella et al., 2008). A dispositional risk propensity could help explain the risk behavior of individuals (Das and Teng, 2001; Furman et al., 2010). McClung's (2002) research into avalanche forecasting showed that risk propensity significantly influences decision making. However, the influence of risk propensity on risk decision making needs to be tested further before being widely accepted, which is one objective of this research. Based on the literature review, this research aims to test the following hypothesis:

H3b. There is a significant positive relationship between risk propensity and bid/no-bid decision making. Decision makers with high risk-taking willingness are more likely to choose high-risk projects; decision makers with low risk-taking willingness may tend to bid low-risk projects.

2.5 Relationship between risk perception and risk propensity
Research indicates that both of risk propensity and risk perception can influence decision making. Meanwhile, some evidence shows that risk propensity has an impact on risk perception (Byrne, 2005). A risk-seeking decision maker tends to recognize and weigh positive outcomes, thereby overestimating the probability of gain or loss (Brockhaus, 1980; Vlek and Stallen, 1980), which leads to a lowering of risk perception. Sitkin and Weingart (1995) highlighted a significant negative relationship between risk propensity and risk perception. However, in the view of Keil et al. (2000), there was no significant relationship between risk propensity and risk perception. Hence, further research should be conducted to analyze the relationship
in the bid/no-bid decision making within the international construction contracting context:

\[ H4. \] There is a significant negative relationship between risk propensity and risk perception. If decision makers are risk seeking or have strong willingness to take risk, they are more likely to perceive low levels of risk in uncertain situations; if decision makers are risk averse, they may perceive high levels of risk.

3. **Conceptual framework and research hypotheses**

Based on the literature review, the following hypotheses were proposed within the conceptual framework (see Figure 1):

\[ H1. \] The outcome history of decision makers has a significant influence on their risk propensity.

\[ H2. \] The magnitude of potential gain or loss has more impact on risk perception than probability.

\[ H3a. \] There is a significant negative relationship between risk perception and bid/no-bid decision making. Higher risk perception indicates less chance of the decision makers to bid high-risk projects; lower perceived risk means that the decision makers are more likely to bid high-risk projects.

\[ H3b. \] There is a significant positive relationship between risk propensity and bid/no-bid decision making. Decision makers with high risk-taking willingness are more likely to choose high-risk projects; decision makers with low risk-taking willingness may tend to bid low-risk projects.

\[ H4. \] There is a significant negative relationship between risk propensity and risk perception. If decision makers are risk seeking or have strong willingness to take risk, they are more likely to perceive low levels of risk in uncertain situations; if decision makers are risk averse, they may perceive high levels of risk.

![Figure 1. Conceptual framework](image-url)
4. Research method
Experiment has been widely adopted by researchers to conduct studies into risk decision making (Sitkin and Weingart, 1995; Keil et al., 2000; Mullins and Forlani, 2005; Grichnik, 2008). This method is appropriate for researches studying risk as a part of the decision-making behaviors. Experimental questionnaire with real monetary rewards was employed to test and verify the hypotheses, investigating the relationships among risk perception, risk propensity, and contractors’ bid/no-bid decision making.

4.1 Experiment design
The probability and magnitude of potential gain or loss were used to distinguish the risk level of different projects. According to the Mullins and Forlani (2005) experiment design, the probability and magnitude were set at two levels. Through an interview with an international contractor, who has more than ten years of working experience in international construction industry, the magnitude was defined as “high” (exactly $2,500,000) and “low” (exactly $500,000), and the probability was kept consistent with Mullins’ experiment, defining “high” as ±30 percent and “low” as ±10 percent. The magnitude values $2,500,000 and $500,000 aim to represent distinguishable profits, instead of specific numbers. Therefore, from the possible combinations, four projects with different probability and magnitude were developed with the same estimated profit (EP) (see Figure 2).

Table II shows the standard deviation of each project, from which the objective risk rankings were derived. Project A has the highest risk score with the high probability

![Figure 2](image-url)
and magnitude, and project C with the low probability and magnitude is the most riskless (see Table I).

At the beginning of the experimental questionnaire was a brief description of the case situation and the four project scenarios (A, B, C, D). Then the subjects were asked to act as the decision makers of the international construction contracting enterprise with scenarios assumed in the outcome history, which was set at three levels: “failed history” (type A), “successful history” (type B), and “no outcome history (type C)”. Thus, subjects who answered the questionnaire in the failed history setting belonged to “failed group”, while those who were manipulated by the successful history are in the “successful group”. In all, three questions were used to check the effect of manipulation of outcome history, and each question was rated by using a seven-point Likert scale. For instance, the probability of occurring negative influences affected by one’s assumed outcome history may be scored by 1-7. Risk perception was measured by two questions about the risk levels and results after the manipulation check of outcome history. By using a seven-point Likert scale for each question, the subjects scored their perception of the overall risk and the certainty of the results for different project scenarios. Afterwards, subjects should choose the project from which they would bid among the four project alternatives and explain the reason for their choices.

The measurement of risk propensity was based on the choice dilemma questionnaire developed by Kogan and Wallach (1964). In all, four questions related to different construction situations were created and the subjects should make a choice among six alternatives. For example, the central person in each situation was faced with a dilemma to choose between alternatives X and Y. As the consultants, subjects were asked to check the minimum odds that they could consider as acceptable to adopt the alternative X.

4.2 Subjects
This research aims to explore the bid/no-bid decision-making process of contractors in the Chinese context. Subjects are required to have ability to make decisions and certain professional knowledge, namely bidding knowledge. A sample of Chinese employees in the construction industry were invited to participate in the experiment, who have adequate construction bidding knowledge and the ability to understand the questionnaires. Finally, 134 available responses were obtained by two ways. Employees with working experience from various Chinese contracting enterprises, who are also master of engineering management (MEM) students in Tianjin University, were invited to the experiment and all the responses were promised to be kept

<table>
<thead>
<tr>
<th>Item</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>91</td>
</tr>
<tr>
<td>Female</td>
<td>43</td>
</tr>
<tr>
<td>Age</td>
<td></td>
</tr>
<tr>
<td>21-25</td>
<td>30</td>
</tr>
<tr>
<td>26-30</td>
<td>80</td>
</tr>
<tr>
<td>31-35</td>
<td>22</td>
</tr>
<tr>
<td>Above 36</td>
<td>2</td>
</tr>
</tbody>
</table>

Table I
Descriptive statistics on subjects

<table>
<thead>
<tr>
<th>Working experience (years)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 2 years</td>
<td>19</td>
</tr>
<tr>
<td>2.5 years</td>
<td>74</td>
</tr>
<tr>
<td>Above 5 years</td>
<td>41</td>
</tr>
</tbody>
</table>
anonymous. The experiment was conducted in a class while the subjects were told that they were going to participate in a study involving bid/no-bid decision making of international projects. Those participants with good behavior would receive a book as the credit for contributions in the study. These books are related to international construction theory and practice, such as “Contract Management in International Construction Projects”, “Project Management”, etc. Thus, subjects were highly motivated to take part in the survey. In addition, the rest of the subjects voluntarily took part in the survey through the internet. Detailed descriptive statistics on subjects in this research are shown in Table II.

4.3 Measurement
The screening showed that 134 valid questionnaires were obtained. Multivariate statistical analysis through SPSS 19.0 showed the probability-probability (P-P) plot of manipulation check, risk perception of each project (A, B, C, and D), and risk propensity. According to the normal distribution of variables indicated in the P-P plot, the following analyses could be conducted. P-P plot can plot the cumulative probability of a variable to examine whether the variable is normally distributed (Montaner et al., 2003; Ghasemi and Zahediasl, 2012).

4.3.1 Data reliability check. The reliability of the scales was first checked by multivariate statistical analysis. Based on the standards set by Nunnally (1978), the data would be reliable if the Cronbach’s $\alpha$ coefficient was no less than 0.70. As shown in Table III, the results of the two-item scales which are used to measure the perceived risk perception associated with each project (A, B, C, D), are reliable and available ($\alpha = 0.746, 0.702, 0.781, 0.746$). The testing indicates the reliability of the data of outcome history ($\alpha = 0.777, 0.724$). The four-item scales used to measure risk propensity have the reliability of 0.721, which is also acceptable. Therefore, it is appropriate to use the average of the relevant scores in the subsequent analyses.

4.3.2 Manipulation check. Manipulation check means that subjects were asked to respond to three Likert items which designed to measure their perceptions of outcome history.

<table>
<thead>
<tr>
<th>Project</th>
<th>Probability</th>
<th>Magnitude</th>
<th>SD</th>
<th>Objective risk ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>High</td>
<td>High</td>
<td>204.124</td>
<td>4</td>
</tr>
<tr>
<td>B</td>
<td>Low</td>
<td>High</td>
<td>117.851</td>
<td>3</td>
</tr>
<tr>
<td>C</td>
<td>Low</td>
<td>Low</td>
<td>23.570</td>
<td>1</td>
</tr>
<tr>
<td>D</td>
<td>High</td>
<td>Low</td>
<td>40.824</td>
<td>2</td>
</tr>
</tbody>
</table>

Table II. The objective risk ranking of projects

<table>
<thead>
<tr>
<th>Variable</th>
<th>Cronbach's $\alpha$</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk perception (A)</td>
<td>0.746</td>
<td>2</td>
</tr>
<tr>
<td>Risk perception (B)</td>
<td>0.702</td>
<td>2</td>
</tr>
<tr>
<td>Risk perception (C)</td>
<td>0.781</td>
<td>2</td>
</tr>
<tr>
<td>Risk perception (D)</td>
<td>0.746</td>
<td>2</td>
</tr>
<tr>
<td>Risk propensity</td>
<td>0.721</td>
<td>4</td>
</tr>
<tr>
<td>Failed</td>
<td>0.777</td>
<td>3</td>
</tr>
<tr>
<td>Successful</td>
<td>0.724</td>
<td>3</td>
</tr>
</tbody>
</table>

Table III. The reliability of the statistics
In total, three Likert scales were used to check whether or not the manipulation of outcome history was successful. Subjects were divided into two groups, those who were manipulated by successful outcome history belonged to the successful group, while others were in the failed group. Results analyzed by an independent samples test are presented in Table IV.

As shown in Table IV, the failed group has a low score of 1.979 while the mean value of the successful group is 6.253, highlighting the difference between the groups. A significance value of 0.819 means that the condition of the equal variances assumed was adopted. The two-tailed significance (0.000 < 0.05) indicates that the difference between failed and successful groups is significant. Thus, it can be inferred that the effect of the manipulation of outcome history is successful and satisfactory.

5. Research findings
Multivariate statistical analysis using SPSS 19.0 and content analysis were used to test the four hypotheses. The results are listed in Table V.

5.1 H1: The outcome history of decision makers has a significant influence on their risk propensity
With the success of outcome history manipulation, an independent samples test was adopted to confirm whether the subjects with different levels of outcome history had different risk propensities. The results are presented in Table VI.

Subjects with the failed outcome history tended to be more risk avoiding than those with the successful outcome history (0.842 > 0.665, a higher value (maximum is 1) denotes lower risk-taking willingness and the risk perceptions were higher in failed situation (see Table VI). Therefore, subjects that accepted different kinds of outcome history (failed and successful) have different values of risk propensities. In addition, according to the results of equal variances in Table VI, the significance value for such differences is 0.000, which suggests that the $H1$ is acceptable.

In Table VII, the percentage of choosing each project is different in various situations, which further illustrates that the bid/no-bid decision-making results differ with different outcome history situations.

A conclusion could be drawn that different levels of outcome history would have a significant influence on the risk propensity of decision makers. Specifically, the more

<table>
<thead>
<tr>
<th>Situation</th>
<th>Number</th>
<th>Mean</th>
<th>$F$ value</th>
<th>Sig.</th>
<th>$t$ value</th>
<th>Sig. (two-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Failed</td>
<td>47</td>
<td>1.979</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Successful</td>
<td>54</td>
<td>6.253</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table IV.

<table>
<thead>
<tr>
<th>Hypotheses</th>
<th>$H1$</th>
<th>$H2$</th>
<th>$H3$</th>
<th>$H3a$</th>
<th>$H3b$</th>
<th>$H4$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Result</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Table V.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Group</th>
<th>Number</th>
<th>Mean</th>
<th>$F$ value</th>
<th>Sig.</th>
<th>$t$ value</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk propensity</td>
<td>Failed</td>
<td>47</td>
<td>0.842</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Successful</td>
<td>54</td>
<td>0.665</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Equal variances assumed</td>
<td></td>
<td>6.672</td>
<td>0.011</td>
<td>5.653</td>
<td>99.000</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Equal variances not assumed</td>
<td></td>
<td>5.512</td>
<td></td>
<td>79.731</td>
<td></td>
<td>0.000</td>
<td></td>
</tr>
</tbody>
</table>
successful the outcome history, the greater willingness the subjects would have to take risks in the international construction contracting context.

5.2 H2: The magnitude of potential gain or loss has more impact on risk perception than probability

By defining the high probability and magnitude of potential gain or loss as “HH” and the low probability and magnitude as “LL”, a two-way analysis of variance (ANOVA) was performed to test the H2.

As indicated in Table VIII, the main effects observed both for the probability and magnitude have a significance value of 0.000, and no interaction effects (Sig. = 0.065) are detected. The comparison of the $F$ values of magnitude and probability (34.123 < 122.358) shows that the probability has more influence on decision maker’s risk perception. In Table IX, when other conditions are assumed the same, the risk perception has a significant variation of 1.682 when comparing the lower probability with the higher probability, while the variation of risk perception in terms of the magnitude is 0.727. Therefore, the range of the probability has a more influence on the risk perception than on the magnitude. This may explain why the perceived risk score is not consistent with the objective risk score in terms of projects B and D (see Table X) to some degree. The findings obtained above are inconsistent with the observations made by March and Shapira (1987) and Keil et al. (2000), who found that the magnitude rather than the probability was a more salient dimension of risk perception.

<table>
<thead>
<tr>
<th>Item</th>
<th>Failed</th>
<th>Successful</th>
<th>No outcome history</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>12.77</td>
<td>12.96</td>
<td>9.09</td>
</tr>
<tr>
<td>Project A</td>
<td>6</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>Project B</td>
<td>9</td>
<td>55.56</td>
<td>14</td>
</tr>
<tr>
<td>Project C</td>
<td>29</td>
<td>31.48</td>
<td>42.42</td>
</tr>
<tr>
<td>Project D</td>
<td>3</td>
<td>0.00</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>47</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Table VII. Result summary of choices

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III sum of squares</th>
<th>Mean square</th>
<th>$F$ value</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected model</td>
<td>176.506</td>
<td>58.835</td>
<td>53.319</td>
<td>0.000</td>
</tr>
<tr>
<td>Probability</td>
<td>135.017</td>
<td>135.017</td>
<td>122.358</td>
<td>0.000</td>
</tr>
<tr>
<td>Magnitude</td>
<td>37.653</td>
<td>37.653</td>
<td>34.123</td>
<td>0.000</td>
</tr>
<tr>
<td>Probability* magnitude</td>
<td>3.835</td>
<td>3.835</td>
<td>3.476</td>
<td>0.065</td>
</tr>
</tbody>
</table>

Table VIII. The subjects’ effects between probability and magnitude

<table>
<thead>
<tr>
<th>Parameter</th>
<th>$B$ value</th>
<th>$t$ value</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>1.788</td>
<td>9.777</td>
<td>0.000</td>
</tr>
<tr>
<td>(probability = 1)</td>
<td>1.682</td>
<td>6.503</td>
<td>0.000</td>
</tr>
<tr>
<td>(probability = 2)</td>
<td>0.000</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

Table IX. Parameter estimates of the risk perception


In the questionnaire, we also asked the subjects an open-ended question about why they made such bid/no-bid decisions, to allow them to provide as many details and as much information as possible. They can use their own words to explain their choices in the scenario. These answers were also analyzed to give additional insight into factors shaping their risk perception, through calculating the appearance times of certain keywords, such as “the magnitude of potential gain/loss,” “gain/loss,” “certainty/uncertainty,” and “the probability of potential gain/loss”.

Among the 134 available responses, 129 subjects submitted written answers. After analyzing the keywords, we found that 100 subjects both mentioned magnitude and probability as factors influencing their choices. In addition, 18 subjects (13.95 percent) considered outcome history or their bidding experience in this context as one factor affecting their decisions, which may indicate the influence of outcome history on risk perception. Among the responses, 35 (27.13 percent) mentioned magnitude as the prime factor influencing their bid/no-bid decisions. Some of the typical explanations are:

1. the fluctuation with the potential loss is subjectively narrowed from the perspective of psychology; and
2. the project has the highest gain and higher probability. I would rather choose one that with higher profit.

Additionally, 59 (45.74 percent) subjects held the opinion that the probability played a more important role during their bid/no-bid decision making. Some of the typical reasons are:

1. this project has low risks and high probability to reach or exceed EP. Therefore the results are more certain; and
2. with high probability to achieve EP, the risk of the project is relatively low.

Although both the factors influence the bid/no-bid decision-making process, the above analysis shows the greater influence of probability, instead of the magnitude, on subjects’ bid/no-bid decisions. The analysis of this open-ended question is thus consistent with that of quantitative analysis.

5.3 H3: Bid/no-bid decision making is significantly influenced by both risk perception and risk propensity

Logistic regression is an appropriate kind of regression method when the dependable variable utilizes dichotomous outcomes, such as bid or no-bid decisions, high- or low-risk projects. Therefore, we applied a binary logistic regression to explore the relationship between explanatory variables (risk perception and propensity) and the response variable (high-/low-risk projects). In this case, by dichotomizing the results by the perceived scores

<table>
<thead>
<tr>
<th>Item</th>
<th>Risk perception (A)</th>
<th>Risk perception (B)</th>
<th>Risk perception (C)</th>
<th>Risk perception (D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objective risk ranking</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Mean</td>
<td>4.761</td>
<td>2.698</td>
<td>2.000</td>
<td>3.791</td>
</tr>
<tr>
<td>SD</td>
<td>1.417</td>
<td>1.171</td>
<td>1.008</td>
<td>1.334</td>
</tr>
<tr>
<td>Number</td>
<td>134</td>
<td>134</td>
<td>134</td>
<td>134</td>
</tr>
<tr>
<td>Subjective risk ranking</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

Table X. The risk ranking of projects through perceived risks
Table XI displays variables in the final logistic regression model, risk perception of project A, risk perception of project B, risk propensity, and constant. It shows that the risk perception of project A (Sig. = 0.007), project B (Sig. = 0.029), and the risk propensity (Sig. = 0.048) have significant influences on bid/no-bid decision making. According to the coefficient of B value in Table XI, the equations representing the model of binary logistic regression can be obtained as follows:

\[
p = \frac{1}{1 + e^{-z}} \quad (1)
\]

\[
z = -1.566 + 0.576 \times RPer(A) - 0.488 \times RPer(B) + 2.919 \times RPro \quad (2)
\]

where, RPer(A) is the risk perception of project A; RPer(B) the risk perception of project B, and RPro the risk propensity; \( p \) the final value of projects; and \( z \) the numerical synthetic influence of risk perception and propensity.

When \( p \) approaches 1, it indicates that the subjects tend to choose the low-risk projects. From the Equation (1) and (2), we can see that having a lower value of RPer(A), a higher value of RPer(B), and a lower value of RPro can result in the value \( p \) approaching 1. Thus, risk perception has a significant negative influence on the decision making while the risk propensity has a significant positive influence. In other words, if the decision makers perceive higher levels of risk, they will tend to choose low-risk projects. If the decision makers have a tendency to take risks, they will probably choose high-risk projects.

Meanwhile, in order to show the influence of risk propensity on bid/no-bid decision making, an independent sample test was performed where the ranking of risk perception of the four projects (A, B, C, and D) differed from the direct answers of ordering they had given in the questionnaire. Those whose direct ordering of four projects is different from the ranking based on their risk perception of four projects are labeled as the inconsistent subjects. The consistent subjects are those whose direct ordering of four projects is the same with the ranking based on their risk perception of four projects. A total of 87 subjects were labeled as the inconsistent group, who are willing to take risks when making bid/no-bid decisions. Table XII shows the result of the
independent sample test. Compared to the consistent subjects, the inconsistent subjects are more risk-seeking ($0.693 < 0.782$, Sig. $= 0.007$). Therefore, this finding indicates that decision makers’ risk-taking tendency explains their choice to some extent. This further confirms the positive influence of risk propensity on bid/no-bid decision from a different perspective.

5.4 H4: There is a significant negative relationship between risk propensity and risk perception
This hypothesis was tested with the correlation analysis. In Table XIII, there exists a significant negative correlation between risk propensity and risk perception of project A, B, C, and D. This means that a risk-averse decision maker tends to weigh negative outcomes more heavily and overestimate the possibility of loss, leading to a heightened perception of risk. In this situation, a risk-seeking bidder tends to overestimate the probability of gain and thus has lower risk perception.

6. Discussion and conclusions
This research studied the bid/no-bid decision making of construction projects from the perspective of Chinese contractors’ risk perception and risk propensity. By analyzing the data collected through experiment and using the multivariate statistical analysis, the following conclusions were drawn:

(1) The outcome history of decision makers has a significant influence on their risk propensity. In other words, a successful outcome history can lead the decision makers to be risk taking when bidding on international construction projects. The result is consistent with that of Sitkin and Weingart (1995), which emphasizes the importance of considering decision makers’ experience. Therefore, when decision makers are facing bid/no-bid decisions, they should consider their own experience as the bidders and try to minimize the influence of outcome history. The managers of contracting enterprises should also pay attention to the experience of decision makers when they select the bid teams.

(2) The probability of potential gain or loss has more impact on risk perception than the magnitude. This finding shows that if decision makers in international construction contracting enterprises perceive risk of bidding projects, they would usually pay more attention to the probability of the potential gain or loss. The result in this study runs counter to that of March and Shapira (1987), Keil et al. (2000), and Reynolds and Nelson (2007), who tested that the magnitude of potential gain or loss played a more salient role. A possible reason was the source of individual, cross-situational, and perhaps cross-cultural differences in risky decision making (Bontempo et al., 1997; Weber and Hsee, 1998). Future research should analyze the reasons causing these differences.
Bid/no-bid decision making is significantly influenced by both risk perception and propensity. There is a significant negative relationship between risk perception and bid/no-bid decision making, while a significant positive influence between risk propensity and the decision making. It indicates that if the decision makers perceived a high risk when making bid/no-bid decision, they would tend to avoid risk. Meanwhile, a risk-taking decision maker is willing to bid for the construction projects with high levels of risk, while a risk-avoiding decision maker would prefer low-risk projects in the international construction contracting context. This finding is consistent with the findings of Ahmad (1990) that although it is an important part of bidding decision-making process to determine the probability of winning, it is not all and this process should be complemented with preference structure and risk attitude of the decision makers. In addition, considering the importance of risk behavior in humans’ decision making under uncertainty, Han et al. (2005) also conducted an experiment to explore the risk attitude of project selections in the international construction environments. Thus, risk characteristics of decision makers, like risk perception and propensity, should not be ignored when it comes to bid/no-bid decision making of international projects.

There exists a significant negative relationship between risk propensity and risk perception. The higher risk propensity of decision makers, the lower level of situational risk is perceived by the decision makers. This result is consistent with the findings of Sitkin and Weingart (1995), and March and Shapira (1987). Risk-seeking decision makers tend to pay more attention to the opportunities inherent in a risk situation than to the threats. But Keil et al. (2000) showed no significant relationship between risk propensity and risk perception in their research in a software development project context. A possible reason is that the relationship between risk perception and propensity is moderated or manipulated by other factors, which needs further research.

This research has both practical and theoretical contributions. Adequate assessment of project risk is important for contractors to make the right bid/no-bid decision making in practice. Through a better understanding of risk propensity and risk perception and their relationship with bid/no-bid decision making of international projects, scholars may be aware of the process or patterns how these risk characteristics influence the way individuals make bid/no-bid decisions and practitioners can better understand their risk characteristics. Thus, when contractors make the bid/no-bid decisions of international projects, they should consider their own risk perception and propensity in order to make reasonable bid strategies. From the findings of this research, risk propensity and risk perception of the contractors should be taken into consideration when researchers develop various risk assessment instruments, which can help contractors appraise project risk more accurately. From the determinants of risk perception, the probability of potential loss plays a more important role in shaping risk perception and thus should be emphasized more when developing risk assessment tools. Thus, more effective risk assessment tools should be developed to help contractors perceive and assess risks accurately.

As to the theoretical contributions, this research adds to the overall body of knowledge relating to risk and risk assessment within the construction management remit. The main stream to study risk assessment of construction projects in previous research is to use quantitative methods, which have both practical and theoretical
limitations (Lin and Chen, 2004). Few studies have paid attention to the characteristics of decision makers, in this case, the contractors. For many years, risk assessment models are built on the assumption that individual are rational or assumption that decision makers act as if their choices and decisions are rational. However, with bounded rationality (Simon, 1976), human’s decisions or judgments are affected by biases and heuristics. Based on the integrated conceptual model of the determinants of risk behavior put forward by Sitkin and Pablo (1992), risk propensity and risk perception are considered in this research. Based on the findings, the characteristics of decision makers have a significant influence on bid/no-bid decision making and should be taken into account in the bid/no-bid decision making of international construction projects. This research provides new approaches for research related to bidding strategies from the perspectives of personal characteristics of the decision makers.

7. Limitations and future study
This research has some limitations. One is the limited number of subjects. As employees are not willing to spend much time on the research, the study chose to get support from MEM students in Tianjin University with working experience and adequate knowledge of construction management. But most of the subjects (74) in this study have only an average of two to five years’ working experience. The findings of this research therefore should be interpreted with great caution. The second limitation is that after the experiment, a book reward was provided as motivation to appeal to the subjects, which may materially affect the reliability of the data. But we also made some efforts to avoid this influence, for example at the beginning of experiment, we have told the subjects this research was totally anonymous and there were no right or wrong answers. Besides, the contractors or the subjects are all from China and we only focus on contractors who making bid/no-bid decisions of international projects in the Chinese context, to some extent the research findings are limited to China, a collectivistic country. The difference within different countries (e.g. cultural or political) should be taken into consideration when applying the results into a different context. Further research can compare different bid/no-bid decision-making patterns in different cultural contexts or in others countries. In addition, some other factors may influence bid/no-bid decision of the decision makers, such as politics, resources, techniques, future development of the enterprise, etc. while this study only focussed on the profit of projects.

The findings of this research indicate that, compared to the magnitude of potential gain or loss, the probability has a stronger impact on people’s risk perception in this bid/no-bid situation, which differs from the findings of Keil et al. (2000) and March and Shapira (1987). The reason for this difference may be a good starting point for further investigation. Risk perception is influenced by various factors, such as outcome feedback of previous decisions, aspiration levels, expectations, and cultures. Thus, further research may explore the relationship between outcome history and risk perception and the mediating role of risk propensity. In addition, future research may increase the sample size, including employees with different cultural backgrounds and various stages of working experience, etc.

References


Further reading


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