Introduction

The business of creating and delivering 'projects' has become an increasingly critical part of the business landscape. Governments and businesses alike employ project methodologies to achieve a transformation agenda or to bring new products to market. Some organisations adopt projects temporarily to achieve their aims, whilst others are dedicated project-driven organisations, who sell their specialist project-based skills to clients. The business of projects however can be a risky enterprise, and there are numerous examples of poorly conceived or managed projects, which have ended in cancellation or failure (Davies & Hobday, 2005). The need to plan for project risks, as well as the practice of risk management in projects are critical for successful outcomes to be realised (Chapman, 1997; Williams, 2005; Anantatmula & Fan, 2013; Teller et al, 2014). Scholars and practitioners are increasingly aware of the importance of project risk management (Raz et al., 2002) to the extent, Nicholas and Steyn (2008) claim project management itself is fundamentally risk management.

As a consequence of economic growth, China is experiencing a rapid development in its construction industry. As indicated in the GLOBE report, with its unique cultural and political environments, China assumes an important role globally in the 21st century (House et al., 2004; Gupta et al, 2002; Shi & Wang, 2011). Interestingly, a study of China's comparative advantage in manufacturing between 1987 and 2005 reports a shift towards higher-tech sectors, particularly in selected medium-tech sectors (e.g. office machines and electric machinery) and the high-tech telecommunications and automatic data processing equipment sectors (Vaidya et al., 2007). Supporting these changes and other industrial shifts in China is a vibrant, yet underperforming construction industry (Deng et al., 2013). Due to the dynamic nature of the construction industry, construction projects usually involve more uncertainties and risks, making it an interesting context for further analysis (Chan et al., 2001; Tang et al., 2007). Past research has shown that project risk factors in China differ from those of in other countries (Zou et al., 2007) and the project risk management system in the Chinese construction industry does not seem formal enough to manage risks

(Tang et al., 2007). Whilst a great amount of research has studied construction projects, knowledge about risk management is constantly developing, and construction industry contractors find effective implementation challenging (Baloi and Price, 2003). This could be attributed to fragmented and unorganized nature of the construction business.

This paper aims to investigate the influence of risk factors on project success in the Chinese construction industry context.

Literature Review

Definitions of risk and project success

Risk is generally seen as an exposure to a situation that leads to unfavourable outcome whereas a project risk is an occurrence that can be either positive or negative. (Anantatmula & Fan, 2013). A project, by definition, is a new endeavour and risks are integral to projects due to uncertainties and unknowns associated with for instance the development of a new product or physical/electronic infrastructure.

Risk identification before and during the project life cycle can determine the success or failure of project risk management to a large extent. Risk factors can be grouped in different categories. Zhou et al. (2008) suggest 5 risk categories along the line of the project life cycle, while Wysocki (2007) grouped them according to risk takers. Risk factors may overlap because the effect of one risk can trigger other risks (Steffey and Anantatmula, 2011). Hence, effectively identifying risk factors can be a thorny but necessary task for project success.

Traditionally, time, cost and quality were used as measures of success or failure of any project (de Bakker et al., 2010). However, there are differences between project success factors and project success criteria (De Wit, 1988). Project success factors are endeavours and elements that contribute to the accomplishments of projects (time, cost, scope) whereas project success criteria are standards used to judge the project outcomes (usability of the project deliverable, market value, performance, etc.).

Project success criteria & measuring project success in the construction industry

Project success criteria mainly concern projects' final products (Baccarini, 1999). They are principles or standards used to make judgment (Kerzner, 2013), which fits the definition of a criterion. Time, cost and quality, known as the Iron Triangle, are the criteria most commonly used to measure the success or failure of a project (Atkinson, 1999; De Wit, 1988; Pinto and Slevin, 1988).

However, scholars have argued that success criteria should be widened since different projects vary in size, uniqueness and complexity (Wateridge, 1998; Dunovic et al., 2016). He also proposed additional criteria for project success, which include meeting specifications, achieving the business purpose, meeting quality requirements, being profitable to the owner, team members, stakeholders and contractors, and users being happy with the project outcome (Wateridge, 1998).

Project success criteria could be different based on a perspective (Lim & Mohammed, 1999; Freeman & Beale, 1992). Shenhar et al. (2001) that proposed four dimensions: project efficiency, impact on customer, business success, and preparation for the future. Westerveld (2003) summarised the project success criteria and clustered them into project result, time, cost, quality, appreciation client, appreciation project personnel, appreciation users, appreciation contracting partners, and appreciation stakeholders. The project success criteria, could be consistently improved since people would judge the success of projects according to their personal objectives (Müller & Turner, 2007).

To sum up, project success criteria focus on project outcomes and they vary depending on various key stakeholders. The success criteria vary from the perspective of the project team, project sponsor, the client, and the end-user of the project deliverable. Hence, the following hypothesis is presented.

H1. There is no relation between construction project success and client risk factor.

Using a survey of Chinese construction supervising engineers, Wang and Huang

(2006) found that *relationships (Guanxi)* is regarded as a very important criterion among stakeholders, making it a distinct feature of Chinese construction industry.

Chan et al. (2001) defined construction project success differently and argued that to achieve construction project success, different project participants such as end-users, client, contractor, architect, and design consultants should be concerned. Chan & Chan (2004) proposed key performance indicators, which include the following:

- Completed on schedule
- Met the requirements of quality
- Commercially profitable
- Environmental performance
- Met user expectation/satisfaction
- Met participants' expectation
- Health/safety

These indicators are aligned to past research, and therefore, considered for this study. Thus, the following hypothesis is presented.

H2. There is no relation between construction project success and designer risk factor.

With the idea that construction project success is repeatable (Ashley et al., 1987), research about success of construction projects is important and relevant. Construction projects usually involve intricate and changing elements such as technology, budgets and development processes (Chan & Chan, 2004). It turns out that the definitions of project success in the construction industry are far more ambiguous. Pinto and Selvin (1988) defined 10 factors for construction project success, of which project mission was believed to be the most critical. After interviewing several architects in Hong Kong, Mo and Ng (1997) concluded that the client’s brief is the most important aspect of success followed by the experience of the client, and the contractor, and a good working relationship. The following hypothesis is proposed based on the aforementioned discussion.

H3. There is no relation between construction project success and contractor risk factor.

Project risk management & the process of risk management

According to Baloi and Price (2003), a direct relationship exists between effective risk management and the achievement of project success factors or criteria, particularly since risks are assessed by their potential effect on project objectives. Notably, risk management does not mean eliminating uncertainty but rather reducing the negative effect of risks (Maylor, 2010).

Furthermore, Nicholas and Steyn (2008) even propose that 'project management is risk management' to underline the significance of risk management. Risk management is considered as the process of identifying, sequencing potential risk factors and coming up with corresponding strategies can effectively alleviate risk consequences (PMI, 2008). Buertey et al. (2012) categorizes the tools and techniques researchers commonly used into two groups. Qualitative risk management techniques consist of risk probability and impact assessment, probability and impact matrix, and risk data quality assessment. Quantitative risk management involves tools such as sensitivity analysis, decision tree analysis, fuzzy set theory, artificial neural networks (ANNs), and so on. In a recent study, data collected between 2002–2012 on 82 federal technology projects across 519 quarterly time periods indicated that early stage complexity risk and later stage execution risk have a significant negative effect on a composite measure of schedule-cost performance, while the negative effect of the procurement-related contracting and subcontracting risk on schedule-cost performance is much weaker (Mishra et al., 2016). The same study also argued that increasing levels of process maturity with the CMMI (a process maturity framework) assisted projects with mitigating the negative effect of project risks on schedule-cost performance. Thus, the following hypothesis is presented.

H4. There is no relation between construction project success and subcontractor risk factor.

A formal risk management process (RMP) is important during the project life cycle according to Chapman (1997). PMBOK, a professional guide to managing projects and ANSI standard recognizes the importance of risk and identified as one of the key knowledge areas for managing projects successfully. A large amount of project risk management processes have been put forward.

Boehm (1991) proposed that RMP contains two main steps: risk assessment and risk control. Risk assessment involves identification and analysis while risk control includes risk management planning, risk resolution, risk monitoring planning, tracking and corrective action. The PMI also describes four steps for RMP, namely, identification, quantification, response development, and control (PMI, 2008).

Chapman (1997) presented a concrete RMP structure, which includes 9 phases: define, focus, identify, structure, own, estimate, evaluate, plan, and manage. Kahkonen (1997) simplified the process to consist of organization and scope, risk identification, risk analysis, risk strategy, response planning, continuous control, and feedback. Carr and Tah (2001) improved it into manipulation of the generic risk data, identification, assessment, analysis, handling and monitoring. Generally, PRM contains 4 main steps: risk identification, risk assessment, planning risk response, and risk monitoring and control. Whilst the so-called hard side of risk management is important for managing foreseeable uncertainties and variability, more recent research has argued that the soft side, or soft skills are also significant for managing unforeseeable uncertainties (Carvalho & Rabechini, 2015). This notion extends to the supply chain, and implies that the understudied social aspects of inter-firm information sharing and trust has an impact on the management of risk (Huong Tran et al., 2016)

Risk factors in the construction industry & Risk factors in the Chinese construction industry

Risk management was introduced as a separate and new field in the construction industry in the 1980s (Thevendran & Mawdesley, 2004). Since construction projects are usually complex and involve a large number of stakeholders, they seem to suffer from more risks than other business activities (Shen, 1997). Construction risks are usually associated with delays and cost overrun. According to Mustafa and Al-Bahar (1991), risk factors can be summarized into 6 groups in construction projects: acts of god risks, physical risks, financial and economic risks, political and environmental risks, design risks, and job sited-related risks. However, most of these studies have concentrated on a single or limited number of risk factors and their effects on a single area, such as cost performance and returns.

Past researchers seem to agree that the following risk factor groups are important to the construction project's success: estimate-related, design-related, level of competition, fraudulent practices, construction-related, economics-related, and politics-related (Jahren and Ashe, 1990; Akinci and Fisher, 1998; Baloi and Price, 2003).

With on-going development in the Chinese economy, the construction industry is also experiencing a rapid expansion（Chen, 1998; Tang et al., 2007). Construction is considered as an important segment of the national economy (Huang et. al, 2013) and its growth is obvious. During the period from 2001 to 2008, the Chinese construction industry gross output experienced an annual average growth rate of 22% (Huang & Bai 2011). With its unique economics, government, cultural and political background, the risk factors in the Chinese construction industry seem different to other countries (Tang et al., 2006; Gunhan & Arditi, 2005). According to Wang and Liu (2004), both researchers and practitioners are working at systematically identifying and managing risks in the Chinese construction industry. The construction industry in China is flourishing due to enormous investments in infrastructure by the government and foreign investors (Fang et al., 2004). Therefore, the following hypothesis is proposed.

H5. There is no relation between construction project success and government risk factor.

Whilst it is possible to assess a range of risk factors (Lai & Lau, 2012)), Wang et al. (2000) suggest that risks associated with China's build-operate-transfer (BOT) focus on political risks, construction risks, operating risks, market and revenue risks, financial risks, and legal risks. Due to differences, especially in culture, risk management in the Chinese construction industry reveals greater divergence (Gunhan & Arditi, 2005). By adopting a triangulated approach, which includes interviews and questionnaires, Tang et al. (2006) recognized 5 main risk factors from 32 risk factors in the Chinese construction industry: poor quality of work, premature failure of the facility, safety, inadequate or incorrect design, and financial risk.

After a series of methodology and systematic analysis on the basis of stakeholders' points of view, Zou et al. (2007) classified 25 major risk factors into 6 groups that are considered comprehensive and thus used in this article:

- **Risk related to clients**: tight project schedule; project funding problems; variations by the client;
- **Risk related to designer:** design variations; inadequate program scheduling; inadequate site information; incomplete or inaccurate cost estimate;
- **Risks related to contractors:** contractors' poor management ability; contractors' difficulty with reimbursement; poor competency of labourer; unavailability of sufficient professionals and managers; no insurance for major equipment; no safety insurance for employees; inadequate safety measures or unsafe operations; lack of readily available utilities on site; unavailability of sufficient amount of skilled labourers; prosecution due to unlawful disposal of construction waste; serious air pollution due to construction activities; serious noise pollution caused by construction; water pollution caused by construction;
- **Risk related to subcontractors/suppliers:** low management competency of subcontractors; suppliers' incompetency to deliver materials on time;
- **Risk related to government agencies:** bureaucracy of government; excessive procedures for government approvals
- **External issues:** price inflation of construction materials

In summary, typical risks associated with constructions projects in China are safety, financial risk, operation risk, relationships among key stakeholders, and political risks.

Research Methodology

This is primarily a survey-based study, as a prelude we conducted ten telephone interviews to identify risk factors before distributing questionnaires for data collection. Data collection is mainly from China.

This research effort is divided into 2 stages. Initially, we interviewed ten professional and experienced project participants that include academic researchers, contractors, sub-contractors, and project managers. They were asked to select ten risk factors out of 25 risk factors in the Chinese construction industry that were identified using literature review. Using these research results, online questionnaires were designed and distributed to get a large sample data for a detailed analysis and understanding.

We adopted quantitative descriptive approach as it can better investigate relationships between variables by testing the hypotheses (Swanson & Holton, cited in Thompson, 2010). A survey questionnaire using a five-point Likert scale (1-5) was chosen because it allows the data to be collected in quantitative terms, and enables different mathematical techniques to be used for analysing the collected data. We received 108 responses to the questionnaire of which, 86 are considered valid.

Questionnaire

As a pilot test of the questionnaire, ten telephone interviews of professional and experienced project practitioners in the Chinese construction industry were considered as prelude to collection of data using a survey questionnaire. According to Garbett and Mccormack (2001), telephone interview is proven to be an effective approach towards achieving the survey results. The initial question was to understand the importance of risk to construction projects in China. All the interviewees agreed that risk management plan is critical for construction projects and felt that without effective project risk management a project can run into serious issues. Interviewees were required to choose the ten most important risk factors from 25 risk factors identified using past research

For this research, an online questionnaire was used. The questionnaire was designed to investigate respondents' attitudes towards risk factors in the Chinese construction industry and project success criteria. There are 12 questions in the questionnaire. The first five questions deal with some background information about the respondent. Question 6 enquires about whether respondents are familiar with the concept of project risk management (Thevendran & Mawdesley, 2004). Question 7, addresses the understanding of the term 'identifying risk factor' in the risk management process. Question 8, is concerned about respondents' attitudes towards 'identifying risk factors' in the risk management process. Through Questions 9 and 10, respondents were required to rate the importance of risk management and identify risk factors for project success. The aim of the study was to learn about the attitude of respondents and to ensure the validity of the questionnaire. Also, responses to these questions were closely examined to weed out invalid responses. Question 11 presents a list of ten risk factors. The 10 risk factors are the outcomes from the telephone interview as discussed previously. Respondents were asked to rate their importance with respect to the project success. Respondents can choose the level of importance from a 1-5 scale where 1 stands for not important and 5 stands for very important. Question 12 is made of 8 factors that were identified using the literature review findings discussed in the previous section. This question is used to identify respondents' criteria for the success of the construction project. The online questionnaire was made available through a Chinese website and results were translated into English after data collection.

Data collection

Based on 86 valid responses, 53% were male and 47% were female and most were involved in both construction and engineering sectors. 77% of participants have a university degree and additionally 15% of them hold a master's degree. It was required that all the respondents should have work experience. Responses toward project success framework are used as an independent variable in the analysis.

Data analysis

After confirming that respondents consider PRM and identifying risk factors to be critical to achieving project success in the Chinese construction industry as shown in Table 2, the Pearson Correlation and Regression are used to test the importance of each risk category respectively. Correlation is commonly used to reveal the relationship between variables in practice (Stock & Watson, 2003). Correlation between two variables, if greater than 0.6, suggests a strong positive correlation. When correlation value is between 0.4 and 0.6, it signifies positive correlation.

Results

When asked about respondents' familiarity with the concept of risk management in projects, about 10% of the respondents admitted that they were not familiar with risk management (Figure 1, appendix). It is quite possible that they may not be familiar with the term but might be practising risk management without following formal risk management processes.

The second question is about the understanding of the term 'identifying risk factor' in the construction industry, and it turns out that most people have knowledge about identifying risk factors in the Chinese construction industry (Figure 2, appendix).

Together, these two questions suggest that people who work in Chinese construction industry are familiar with project risk and identifying risks. However, familiarity need not be construed as practising risk management formally.

Questions that deal with the respondents' attitude toward project risk management and identifying risk factors in construction projects suggest project risk and identifying the risk factors are considered important. Most people connect project success with effective risk management and correctly identifying the risk factors (Table 1, appendix).

Table 2 in appendix shows that overall project success is significantly and positively correlated with all risk categories; client-related risks have the closest relationship with project success while risks related to government, with a correlation of 0.5, have the lowest relationship with project success.

A high correlation indicates that independent and dependent variables show a certain relationship while not representing a linear function (Cohen & Cohen, 1975). Thus, regressions are performed to test and reveal the significance level and risks related to client, designer and subcontractor are considered to contribute for project success with correlations of 0.603, 0.683 and 0.566, respectively.

Furthermore, we investigated whether the 5 risk categories have an impact on construction projects' success using a linear regression. R Square is the fraction of the variation between dependent variables and independent variables (Stock & Watson, 2003). As the results (Table 3, appendix) shows, the R Square is 0.698, which indicates a low data variation and a linear relationship. Another number that needs to be noted is Durbin-Watson. The Durbin-Watson statistic has been uncritically used to test if lagged endogenous variables are contained in the relationships of serial correlation in the residuals. With some methods that include simultaneous and single equations, the endogenous variables can be estimated (Nerlove & Wallis, 1966). In such a case, Durbin-Watson is 1.915, which suggests no presence of auto-correlation. B refers to the coefficient of the regression equation. The magnitude of those coefficients indicates the relationship between all independent variables and dependent variables.

VIF refers to Variance Inflation Factor. It is used to test whether there is multi-collinearity existing in the regression (Stock & Watson, 2003). VIF should be less than 10 in the regression model. The last noticeable term is Sig. It is known as P-value. P-value is the probability that exists in a test statistic in the observed data when assuming that the null hypothesis is true (Stock & Watson, 2003). It should be less than 0.05 to prove that the coefficient is significant. In this survey results, all P-values are significant.

Results of Hypotheses Testing

The first hypothesis concerns the relationship between the risk factor related to client and construction project success. As the results shows, the significance level is 0.000. Since it is less than 0.005, the null hypothesis is rejected. Figure 3 shows a linear relationship between the risk factor related to client and construction project success. Since the coefficient is 0.489, the risk related to client presents a positive and relatively high correlation with project success.

The regression line in Figure 4 is clearly flatter than in Figure 3 and therefore, the risk related to client shows the strongest correlation, while the risk related to government indicates weaker correlation. Statistical results of all other factors are very similar and therefore, not included here.

To sum up, the risk categories have a significant impact on the Chinese construction projects' success. However, for different risk groups, the impacts vary (Table 4, appendix), which necessitates examination of the correlations of each risk category and an investigation of other reasons by comparison with the survey results of Zou et al. (2007). This evaluation focused on the ranking of each risk factor (number in the brackets) in general, instead of the specific data.

Discussion

Our research results show that risk factors related to client (project funding problems and variation by client) are deemed to be the most important risk factors for Chinese construction projects in terms of achieving success. Thus, hypothesis 1 is rejected. This is also confirmed by Zou et al. (2007) and Fang et al., (2004), who report high significance as well. Therefore, it supports past research that funding/payment shortage problems usually appear in overseas construction projects or in developing countries (Zhi, 1995; Frimpong et al., 2003; Baloi & Price, 2003).

It is also observed that defaulting on construction cost commonly occurs in Chinese construction projects. Contrary to Pinto and Slevin (1987) findings that allocation of sufficient resources – such as finance, manpower, and time – is considered critical in the preparation process of project management, only a few contractors prepare financially in the Chinese construction industry. This may be attributed to uncertainties and long project life-cycle in Chinese construction. In addition, financial closing risk occurs when the cost of financing is too high (Wang et al., 2004).

More recent research on the construction industry in China argues the importance of fairer allocation of risks between the client and its contractors, avoiding the trend of client's shifting excessive risk to contractors, which can fuel the contractor's adversarial behaviours and result in higher premiums (Zhang et al., 2016).

Risk related to designer

Null Hypothesis 2 is rejected as our results show that identifying the risk factor related to designer is important for project success. In this context, it is important to note that inadequate project scheduling has a high correlation with construction project success in China (Zou et al., 2007). However, due to fierce competition, many contractors sell projects with a shorter project schedule than is actually needed (Bajracharya, 2009) and this practice is common in the Chinese construction industry.

China has been developing at considerable speed since 1980 (Chen, 1998) and therefore, infrastructure and construction are also experiencing rapid development (Huang et. al, 2013). It seems that 'rapid' has become a key word for development in the Chinese construction industry. Thus, when bidding for projects, it is also common for contractors to have a shorter schedule to prepare and bid.

Our results suggest that inadequate site information is an important risk factor, however with a relatively low importance as compared to past studies (Zou et al., 2007). When calculating the importance of each risk factor, we grouped them into five categories and this might explain our results. Nevertheless, the consequence from inadequate site information cannot be overlooked. Inadequate site information can result in improper design (Wang et al., 2004).

Our research results and past studies suggest that many construction project managers tend to respond in a short time without acquiring adequate site information thereby impeding the success of construction project success in China. A systematic risk management process including risk identification, risk assessment, planning risk response along with risk monitoring and control is necessary.

Risk related to contractor

Our results show that risk related to contractor influences the performance of Chinese construction projects significantly. The risk related to contractor is found to be more important and our results differ from Zou et al.'s (2007) findings. Our results show that the correlation between risk related to contractor and project success is 0.683 and it ranks second among the risk categories.

A suitably qualified contractor plays an critical role in the project risk management process (Turskis et al., 2008) particularly in industries operating on low profit margins, where respective objectives conflict and risks are pushed lower down in priority from client to main contractor, or further still to lower tier suppliers (Wood & Ellis, 2005). The contractor's risk management competencies have the potential to negatively affect whole project success and stakeholder satisfaction. (Cheng, 1995; Hemlin, 1999). Contractors will also differ in terms of their level of aversion to risk, which relates to their abilities to (a) assess the risk, and (b) implement strategies to deal with the risk internally and throughout the supply chain (Kumar et al., 2014).

Risk related to subcontractor

Consistent with Zou et al.'s (2007) findings, our results show that risk related to subcontractor has a correlation of 0.566 (see Table 4) with construction project success. However, their importance to project success is underestimated (Kumaraswamy & Matthews, 2000). Some of the risks related to subcontractors are improper and flawed selection of subcontractors, and working on multiple projects concurrently. It is common for contractors to use subcontractors who offer the lowest price. Also, based on data from recent research of study in Hong Kong, it is argued that adopting a multi-layer subcontracting system contributes significantly to risks affecting time, quality, communication and coordination performance (Tam et al., 2011).

Risk related to government

Our results show that it is the least important risk factor among all, although it cannot be considered insignificant. Risks related to government are due to the lengthy approval process in China. It is important for the project-team to ‘maintain a close relationship with government officers’ (Zou et al., 2007). Unfairness in the tender process, local protectionism and bureaucracy resulting in loss were reported as significant external risk factors in China (Fang et al., 2004).The relatively low correlation in our study suggests that the situation of government bureaucracy might be improving with respect to the Chinese construction industry.

In summary, the research questionnaire is designed to explore relations among 5 risk categories and construction project success. Our results show that all risk categories present positive correlation with project success and null hypotheses were rejected. Risk related to client shows the highest correlation, while risk related to government shows the lowest correlation.

Conclusion

We defined five risk categories using literature review findings and our results show that all of them are critical for the success of project management in the Chinese construction industry. Of the five risk categories, risk related to the client is found to be the most important relationship with project success. It involves project funding problem and variation by clients. Risk related to contractor is ranked second. It is desirable that contractors try to grasp and understand how to transfer knowledge into practice in every stage of project management). Risks related to designer, subcontractor and government influence project success to a lesser degree. However, our results show that all the five risk categories should not be ignored, but they can be prioritized. Within the JMTM literature there is a growing body of research where 'projects' provide the context of a scholarly investigation, yet the discipline of project management requires much more attention. This is particularly pertinent given both macro-level (e.g. evidenced-based policy and investment decisions) impacts and micro-level impacts (e.g. profitability and new innovations) that project management can have on shaping markets and societal benefits. The mitigation of risk through effective project management practice is a valuable area of exploration in the construction industry, and would benefit from further studies conducting international comparisons, or contrasting differences with other capital-intensive, large-scale complex products and systems industries. In the near future, the construction industry may also look to understand and manage risks associated with disruptive new technologies such as additive layer manufacturing (Kothman and Faber, 2016; Bai et al., 2017).

As a follow-up to this research effort, future studies may consider including a larger population from the construction industry and may identify additional risk factors to evaluate their impact on project success.

Identifying risk factors is only a first step in the Project Risk Management. A series of effective risk management procedures such as risk assessment, risk response, risk monitoring and control are important and further research on other processes may be considered to develop a comprehensive understanding of the risk management in the Chinese construction industry. Further, specific work conditions and culture in China may be further investigated as they are likely to present new findings.

Limitations

Although the authors have tried to minimize limitations in the course of the research, there are several flaws that are mentioned below.

First of all, picking 10 major risk factors from 25 available in literature lacks theoretical support. And even though people who are required to choose the most important risk factors are experienced project participants, the results may still be subjective. Ten telephone interview participants was a small sample size to adopt. It is probable that such a small sample can cause bias to the survey results. Lastly, interviewees are from one district in China and may all present a specific district trait, especially as China is a huge country with varied development levels among its districts.

The second limitation is the design of the questionnaire; the first 5 questions are developed through monitoring other related literature, while questions 11 and 12 are designed by the authors based on the research requirements. Without help from other studies, the questions may have been defective or needed modification. Moreover, the questionnaires were distributed in China. Although the author has tried to find a way of faithfully translating into English when referring to studies in Chinese, differences in translation remain. Finally, the study makes use of 86 questionnaires in total and respondents hail from various industries. They represent different areas and sectors; however, there is still the possibility that respondents may not understand how the process of construction projects is run in China.

Lastly, when analyzing the relationships between risk factor and construction project success, the authors combined the risk factors into five groups. However, in the questionnaire they are presented independently; a test is made to check if the difference is significant. We have tested each factor separately, and it turns out that the difference is tiny. However, the possibility of causing such a difference remains.

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Appendix

FIGURES

Figure 1. Respondents' familiarity with the concept of project risk management

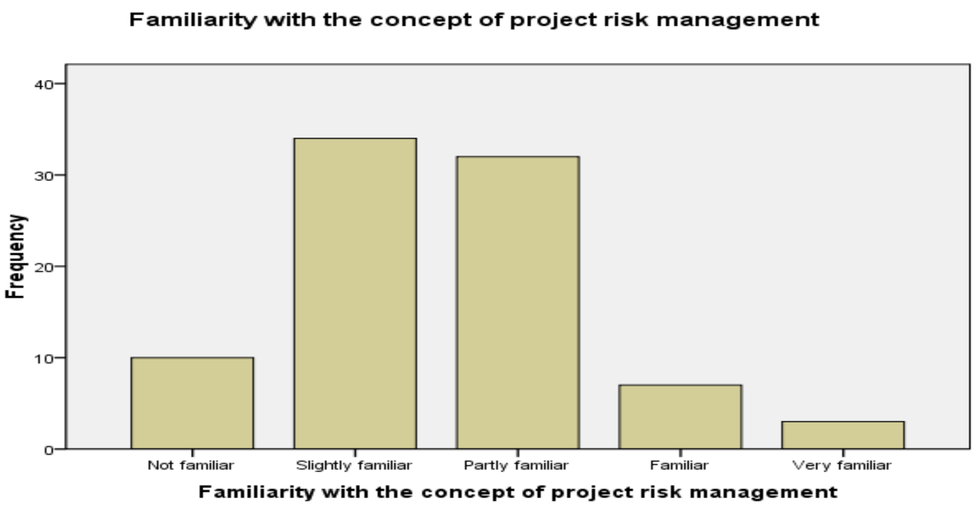


Figure 2. Respondents' understanding of the term 'identifying risk factor' in the PRM process

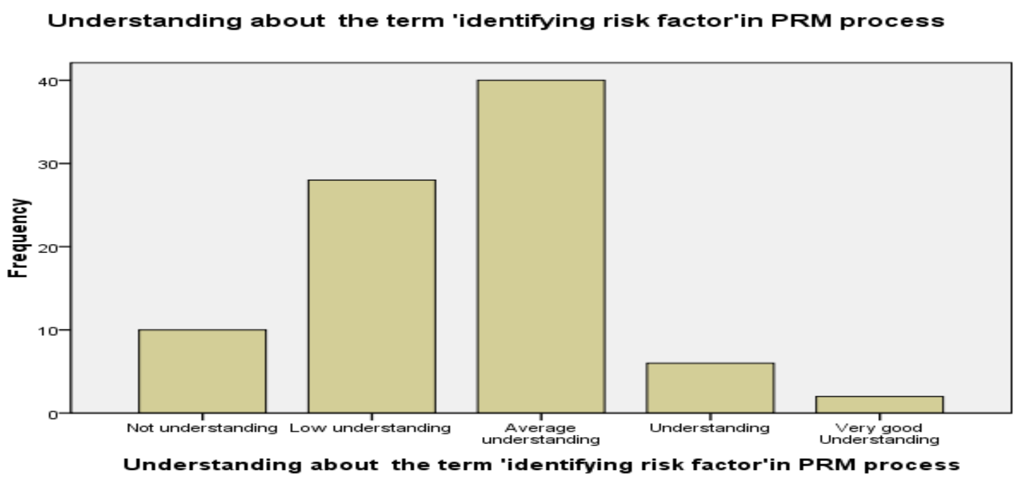


Figure 3. Scatter Plot of relationship between risk related to client and project success

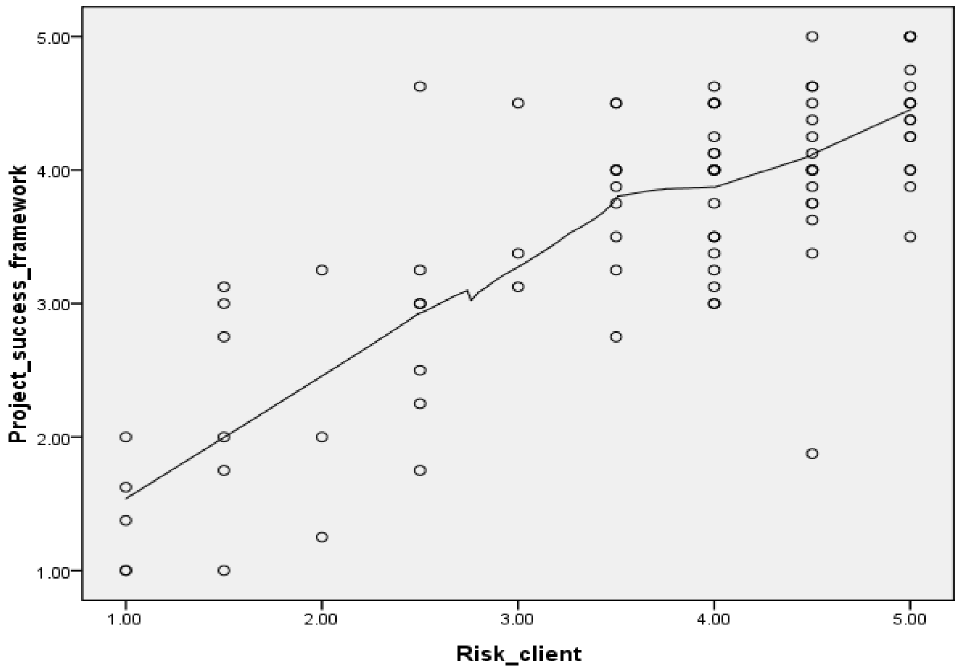
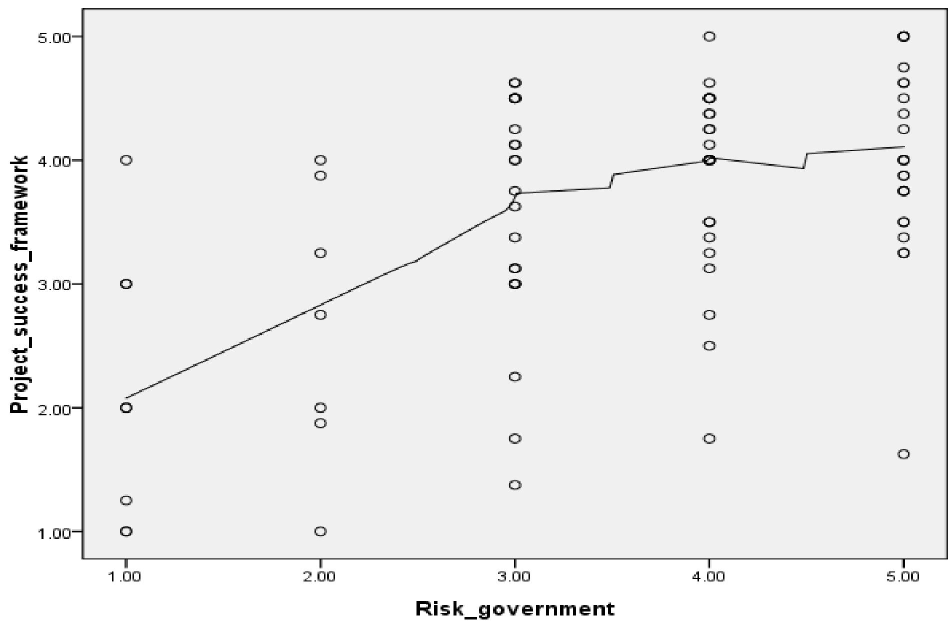


Figure 4. Scatter Plot of relationship between risk related to government and project success



TABLES

Table 1. Descriptive results of Question 8, 9, 10

	N	Minimum	Maximum	Mean	S.D.
Is PRM important to construction projects' success?	86	1.00	5.00	3.9651	**.93868**
Is 'identifying risk factor' important to the construction risk management process?	86	1.00	5.00	**4.1279**	.79404
Is 'identifying risk factor' important to construction projects' success?	86	1.00	5.00	4.0465	.82472

Table 2. Bivariate Correlation Results of risk categories and project success framework

	Project success framework	Risk Client	Risk Designer	Risk Contractor	Risk Subcontractor	Risk Government
Pearson Correlation	1.000	**.783**	.603	.683	.566	**.510**

Table 3. Regression results of risk categories and project success framework

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.835[a]	.698	.678	.58123	**1.915**

Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	.356	.280		1.272	.207		

Risk_client	**.489**	.075	.569	6.481	.000	.497	2.012
Risk_designer	.335	.104	.031	.331	.041	.433	2.311
Risk_contractor	.264	.124	.223	2.124	.037	.347	2.881
Risk_subcontractor	.149	.078	.163	1.907	.049	.522	1.915
Risk_government	**.019**	.068	.022	.271	.047	.582	1.719

Table 4. Correlation and survey results

	Risk factors in the Chinese construction industry	**Correlation**	**Significance-Zou et al.**
Risk related to client	Project funding problems Variations by the client	**0.783(1)**	**0.58(1)** **0.58(1)**
Risk related to designer	Inadequate program scheduling Inadequate site information	0.603(3)	0.53(2) 0.34(8)
Risk related to contractor	Contractor's poor management ability Poor competency of labourers Inadequate safety measures or unsafe operations Unavailability of sufficient number of skilled labourers	0.683(2)	0.43(3) 0.4(5) 0.38(6) 0.41(4)
Risk related to subcontractors	Low management competency of subcontractors	0.566(4)	0.35(7)
Risk related to government agencies	Government bureaucracy	**0.51(5)**	**0.23(9)**