

The Use of Project Risk Management in the Southeastern United States Construction Industry

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Every construction project has unique risks. Therefore, firms may take a proactive approach in identifying potential risks, calculating their probability of occurrence, assessing their potential impacts, and planning appropriate responses. The risk register tool facilitates this. However, not all companies undertake such project risk management (PRM). This Masters research investigates factors that are motivators or barriers to its use. A survey of 186 companies solicited information about the general characteristics of the respondent and the company, whether or not the company uses PRM, and what factors impact the use or non-use of PRM. Inferential tests were performed to determine whether relationships exist between any of these characteristics and the use or non-use of PRM. The findings show a little association between the use of PRM and general characteristics of respondents or companies. Motivating and impeding factors point to the use of PRM based on leadership understanding of a project challenge and knowledge and training in the use of PRM.

Key Words: Project Risk Management, PRM, Training Needs, Risk Register

Introduction

Every construction project, regardless of size or complexity, contains risk. The response to risk varies considerably depending upon the nature of the risk, the scope of the project, the value of the project, the contractor's risk acceptance, and many other factors. For many projects, success or failure hinges on the implementation of an effective project risk management (PRM) strategy and tools.

Strategies and tools vary from one contractor to another, but most share key characteristics: early identification of risk items, assessment of their probabilities, estimation of their impacts, and responses. However, PRM is not applied to all projects or by all contractors. Managing risks requires resources: time, money, and knowledgeable people. When competition for projects is tight, the perceived benefits of PRM may not be sufficient to warrant the investment of these resources in PRM (Akintoye and MacLeod, 1997; Hwang et al., 2013).

Research Problem

PRM is often cited as critical to project success (Hlaing et al., 2008; Zwickael and Ahn, 2010). Pike and Ho (1991) indicate that companies that utilize PRM hold a competitive advantage over firms that do not. Dunning (2012) observes as the construction sector is slower to recover than most of the economy, some construction companies are more likely to take on project types that are outside their areas of expertise, venturing into unknown territory. This decision results in surety failures and subcontractor default claims.

The lack of usage of PRM within construction is not due to a lack of tools, but rather that few tools are used in practice (Zwickael and Ahn, 2010). Many project managers do not view risk management as part of their jobs (Raz et al., 2002). Research also indicates significant differences in the usage of PRM. Lyons and Skitmore (2004) indicate moderate to high usage within their pool of respondents in Australia, but Hwang et al. (2013) and Adedokun et al. (2013) showed low levels of adoptions of risk management techniques in Singapore and Nigeria, respectively. The lack of an identifiable pattern of usage makes extrapolation of existing data difficult.

Given the clear benefits of using PRM, the lack of hard data within the US, and the relatively small rates of implementation in other countries, what is the best way to promote project risk management in the US? Why do so few construction management professionals use PRM, and how are the barriers to use PRM overcome?

The goal of the research is to address the question: What are the barriers to the implementation of PRM among general contractors and construction management firms? The issues to answer include:

- **What is the proportion of GCs that implement PRM?**
- **For those that use PRM, what are the drivers for the decision to implement?**
- **For those that do not use PRM, what are the primary obstacles and impediments?**

It was hypothesized that data would show fewer than 50% of the respondents use PRM and that those companies using PRM will do so when 1) the scope is particularly complex, 2) a tight schedule is required for on-time completion, and 3) when a large sum of money is on the line. Finally, for respondents not using PRM, the primary barriers will be that they lack familiarity and/or training with methods and concepts and that they do not see the benefits of use. The target population was commercial building contractors with average annual sales volume between $100MM and $500MM located in the metro Atlanta area.

Literature Review

Literature explains risk and risk management and presents information on the contents and use of the risk register - a key tool in PRM. From the literature review, we synthesized a description for PRM as containing the following elements:

- **Proactive identification of project-specific risk factors that may negatively affect cost, schedule, or quality.**
- **Prioritization based upon an assessment of the probability of occurrence and possible impact.**
- **Planned response to each risk item, tailored as appropriate for unique circumstances.**

Risk is defined in a variety of methods. Adedokun et al. (2013) state risk is *the possibility of something bad happening at some time in future, dangerous situation or a bad result* and *the likelihood that harm will occur.* Allen and Yin (2011) state risk *reflects variation in the distribution of possible outcomes, their likelihood, and their subjective values.* Akintoye and MacLeod (1997) believe that risk is composed of the two elements of thread and vulnerability - threat has the capacity for a negative effect, and vulnerability is what allows a threat to be exploited. Sharma (2013) and Adedokun et al. (2011) divide risk into internal and external. Osipova and Eriksson (2011) uses tiered categories: global risks encompass financial, political, environmental, legal, and economic; internal risks include design, construction, management, and relationships; and force majeure risks stand alone. Williams (1994) uses the terms *aleatoric* to describe a risk that arises from random variability and *epistemic* to describe the risk that is the result of a lack of knowledge.

Risk Management in construction is addressed to ensure project success. Giel-Tucker (2002) notes that risk management is the *methodical identification and treatment of risks, with the goal of sustaining benefits.* Alarcon et al. (2011) state that understanding of the inherent risks of a project is necessary to control costs and that PRM is both an art and science that must consider the range of possible outcomes. Hwang, Zhao, and Toh, (2013) believe effective PRM should have a formalized methodology because it cultivates *strong risk awareness and the flow of risk management information throughout the entire project lifecycle*.

Industry has employed the Risk Register as a PRM tool for several decades. Williams (1994) states that a risk register is a *repository of a corpus of knowledge and* elaborates it two roles. First it is a list of possible adverse events; those events should be well defined. Second, it *initiates the analyses and plans that flow from it*. The risk register must be a living document that is updated throughout the project. It must also be a collaborative effort, representing input from all stakeholders and team members (Giel-Tucker, 2012; Corbett and Grigg, und.). Corbett and Grigg (und.) point out also the necessity for the risk register used proactively. Patterson and Neailey (2002) describe the development, construction, and testing of their Risk Register Database Systems and Risk Assessment Tool, which creates a graphic report generated directly from the updated register depicting an overall profile of a project's risk at a particular point in time. An analysis of risk is best if likelihood and impact are expressed in quantifiable terms. Often that means using some method to turn a qualitative measure into a quantitative one. One method is the Analytical Hierarchy Process (AHP) that Sharma (2013) describes AHP as *a robust and flexible multi-*

criteria decision analysis methodology. AHP allows the risk factors for a decision to be given some objective weight. The Monte Carlo simulation method uses a range of values for each variable, where a minimum, a maximum, and a "most likely" are given. Patterson and Neailey (2002) state that their belief that Monte Carlo simulation is a useful technique in risk management in car manufacturing, but qualify that it can be costly and time-consuming. While these two methods may be useful in construction PRM, it is notable that they may require some specialized training, and often special software as well. As such, their use may not be within the practical skill set of most project managers.

Barriers to PRM literature indicates that there are still obstacles to its implementation. Hwang, Zhao, and Toh (2013) surveyed respondents about possible reasons that PRM may not be used on a project and found that the top four reasons were "lack of time", "lack of budget", "low-profit margin", " and "not economical." Many small and medium companies may not implement PRM because they lack expertise. This point is echoed by Adedokun et al. (2013) in their finding that inadequate training on PRM is the top-ranked reason it is not implemented. Akintoye and MacLeod (1997), in their survey of contractors and project management firms, find that among the top reasons PRM was not used were a lack of familiarity with methods and an inability to see the benefits.

Methodology

The study investigated the factors that drive the decision to use PRM and the factors that impede its use. A two-part mixed method research project methodology was used. Phase One of the research was qualitative in nature and phenomenological in approach. A research group of six professionals employed in construction operations was selected to serve as advisors to craft and validate the survey. Candidates for this pool were solicited from among this author's network of professional connections. This pool was not limited to the metro Atlanta area, to ensure against bias due to one of the author's current employment. Research group participants had a minimum of eight years' experience as a project manager, operations executive, or both. The research group activities did not meet expectations. Difficulties were encountered in arranging times to conduct discussions and in some cases contacts who had signaled interest in initial inquiry could not be reached at all. While some feedback was obtained from other contacts, the study of the available literature played the greatest role in the final development of the survey instrument.

Phase Two was a survey distributed to participants via SurveyMonkey.com. The survey pool was created from Dodge Data & Analytics' website and filtered for general contractors with addresses in the Atlanta – Sandy Springs – Marietta area of Georgia. The list of survey recipients was based upon a database of AEC practitioners obtained from Dodge Analytics, a leading industry research firm. Every potential recipient's information was verified from the company website. Closer examination of the survey group members showed that some of the companies conducted, at least, a portion of their businesses in roles other than that of a general contractor or construction manager, such as architects and engineers. As a result, the survey included a question as to which such role best describes the majority of their work. Though the survey instrument targeted senior project managers and operations and company executives – individuals who have authority over and accountability for project success – it was not feasible to verify each contact's role within his or her company before sending out the instrument.

General background data solicited for the survey included questions about both the respondent and the company. Information solicited about the respondent included 1) number of years in construction, 2) number of years with a current employer, 3) role with the company, and 4) education level attained. Information solicited about the company included: 1) contract revenue for the prior fiscal year, 2) median project size, 3) public-sector work as a percentage of the whole, and 4) the category that best described the company's work (e.g., general contractor, architect, civil engineer, etc.). Participants were then asked to rank nineteen different types of construction in terms of relative importance to the company's operations. Types of construction ranged from bridges and streets to healthcare to ecumenical and other types. The relative rankings were Primary, Secondary, Some, Minor, and N/A. Additionally, respondents were asked to address whether their company used PRM. The survey instrument that went to participants defined PRM for the respondents as a systematic approach including the following elements: (a) Proactive identification of project-specific risk factors that may negatively affect cost, schedule, or quality; (b) Prioritization based upon an assessment of the probability of occurrence and possible impact, and (c) Planned responses to each risk item, tailored as appropriate for unique circumstances. If "yes," they were asked to rate how strongly the following factors influence their decision to use PRM: Scope, schedule, budget, owner requirement, third party requirement, or other. If "no," they were asked to rate how strongly the following factors influenced their

decision not to use PRM: Lack of familiarity, lack of training, lack of time, lack of budget, inability to see the benefits, or other. They were asked to rate each factor on a five-point Likert scale with 5 as "very important", 4 as "important", 3 as "somewhat important", 2 as "not important", and 1 as "N/A". While these ratings are subjective and open to interpretation, they give an idea of each factor's relative significance.

The survey was emailed to 186 contacts. To ensure participation by the companies, two reminders were emailed. Also, telephone calls were made to survey group members to solicit further participation. In some cases, contact information used was out of date, and another point of contact within the company provided a response. Because the resulting data was to be tested for differences between the group of firms that use project risk management and those that do not, an answer to the survey was considered incomplete if the question as to whether the company uses PRM remained unanswered.

Results

The SurveyMonkey.com survey was emailed to 186 recipients. Of the 47 responses collected, four were incomplete. The remaining 43 were sufficient to complete an analysis. The response rate for the survey was 23.1%.

Survey results were tested using descriptive and inferential statistical analyzes to discern whether differences between PRM users and non-users for a particular variable were statistically significant, or whether differences were due to random variability. The results of each question were compared between the group of those companies that uses PRM and those that do not. The majority of variables analyzed were presented as Likert scale questions, with ordinal values. In these cases, the independent samples t-test was determined to be the best measure of significance. One variable had numerical values as responses and was also tested by the independent samples t-test. Finally, one variable's values were nominal and was thus tested using the chi-square test of association.

The survey questions asked were designed to generate values for variables that could be analyzed for descriptive statistics and inferential statistical tests for association between variables. Those questions soliciting general information about the respondent (questions 1 – 4) resulted in variables described as follows (see Table 1):

Table 1 – Respondent General Characteristics

Variable / Type	Value	N	%
Q1. Experience (N = 43) / Ordinal	1. < 1 year	2	4.7%
Mean = 4.71	2. 1 – 2 years	0	0.0%
Median = 5.00	3. 2 – 5 years	1	2.3%
Mode = 5	4. 5 – 10 years	1	2.3%
	5. > 10 years	39	90.7%
Q2. Tenure (N = 43) / Ordinal	1. < 1 year	2	4.7%
Mean = 3.98	2. 1 – 2 years	5	11.6%
Median = 4.00	3. 2 – 5 years	2	4.7%
Mode = 5	4. 5 – 10 years	14	32.6%
	5. > 10 years	20	46.5%
Q3. Position (N = 42) / Ordinal	1. Project / office / field engineer	6	14.3%
Mean = 3.48	2. Project Manager	5	11.9%
Median = 4.00	3. Sr. Project Manager	5	11.9%
Mode = 5	4. Head of Operating Unit	14	33.3%
	5. President	12	28.6%
Q4. Education (N = 42) / Ordinal	1. Less than High School Degree	0	0.0%
Mean = 5.11	2. High School or Equivalent (GED)	2	4.8%
Median = 5.00	3. Some College	1	2.4%

Mode = 5	4. Associate Degree	1	2.4%
	5. Bachelor Degree	26	61.9%
	6. Graduate Degree	12	28.6%

Questions 5 – 9 solicited general information about the respondent's company and resulted in variables described as follows (See Table 2):

Table 2 – Company General Characteristics

Variable / Type	Value	N	%
Q5. Payroll (N = 39) / Numerical	1. 0 – 50	15	38.5%
Mean = 636.24	2. 51 – 100	5	12.8%
Median = 100.00	3. 101 – 1,000	16	41.0%
	4. 1,001 – 10,000	2	5.1%
	5. > 10,000	1	2.6%
Q6. Annual Revenue (N = 43) / Ordinal	1. < $5 million	2	4.7%
Mean = 3.43	2. $5 - $10 million	6	14.0%
Median = 4.00	3. $10 - $25 million	9	20.9%
Mode = 5	4. $25 - $100 million	12	27.9%
	5. > $100 million	14	32.6%
Q7. Project Size (N = 43) / Ordinal	1. < $100,000	0	0.0%
Mean = 4.84	2. $100,000 - $500,000	2	4.7%
Median = 5.00	3. $500,000 - $1 million	6	14.0%
Mode = 6	4. $1 - $5 million	10	23.3%
	5. $5 - $10 million	8	20.9%
	6. $10 - $25 million	12	27.9%
	7. > $25 million	5	11.6%
Q8. Public Sector (N = 43) / Ordinal	1. < 20%	17	36.5%
Mean = 2.86	2. 20% - 40%	4	9.3%
Median = 2.50	3. 40% - 60%	1	2.3%
Mode = 1	4. 60% - 80%	8	18.6%
	5. > 80%	13	30.2%
Q9. Company Role (N = 43) / Nominal	1. General Contractor	30	69.8%
Mode = 1	2. Construction Manager	4	9.3%
	3. Owner	1	2.3%
	4. Owner's Representative	1	2.3%
	5. Architect (non-landscape)	1	2.3%
	6. Landscape Architect	0	0.0%
	7. Electrical Engineer	0	0.0%
	8. Mechanical Engineer	0	0.0%
	9. Structural Engineer	0	0.0%
	10. Civil Engineer	1	2.3%
	11. Consultant	0	0.0%
	12. Interior Designer	0	0.0%
	13. Other	5	11.6%

Question 10 was a multivariable question that asked respondents to rank the importance of nineteen different types of construction about their company's operations. The possible responses were: 1) N/A (not applicable), 2) minor, 3) some, 4) secondary, and 5) primary. Dodge Data and Analytics defined the types of construction. The types of construction that received the highest rankings were Education, ranked as "Primary" by 23.3%, Healthcare by 20.9%, and Retail by 18.6% (see Table 3). The most common types of construction overall (those undertaken regardless of ranking) were Retail (62.8%), Education (60.5%), Healthcare (58.1%) and Office (58.1%). The most common ranking for all types of construction was "N/A." This response is likely because companies will tend to specialize in a small number of types of construction, and thus, a plurality will not engage in a single type. (See Table 3).

Table 3 – Types of Construction

Type of Construction (N = 43)	Primary		Secondary		Some		Minor		N/A	
Bridges	2	(4.6%)	1	(2.3%)	2	(4.6%)	2	(4.6%)	36	(83.7%)
Dams / Flood Control	0	(0.0%)	0	(0.0%)	4	(9.3%)	1	(2.3%)	38	(88.4%)
Dormitories	1	(2.3%)	4	(9.3%)	4	(9.3%)	4	(9.3%)	30	(70.0%)
Education	10	(23.3%)	3	(7.0%)	7	(16.3%)	6	(14.0%)	17	(39.5%)
Government Building	4	(9.3%)	8	(18.6%)	3	(6.9%)	5	(11.6%)	23	(53.5%)
Healthcare	9	(20.9%)	2	(4.6%)	6	(14.0%)	8	(18.6%)	18	(41.9%)
Hotels	1	(2.3%)	3	(7.0%)	5	(11.6%)	2	(4.6%)	32	(74.4%)
Manufacturing	3	(7.0%)	5	(11.6%)	4	(9.3%)	3	(7.0%)	28	(65.1%)
Multifamily	3	(7.0%)	3	(7.0%)	6	(14.0%)	2	(4.6%)	29	(67.4%)
Office	5	(11.6%)	9	(20.9%)	5	(11.6%)	6	(14.0%)	18	(41.9%)
Other Nonbuilding	2	(4.6%)	3	(7.0%)	2	(4.6%)	3	(7.0%)	33	(76.7%)
Parking Garage	2	(4.6%)	6	(14.0%)	6	(14.0%)	3	(7.0%)	26	(60.5%)
Power Utility	0	(0.0%)	1	(2.3%)	1	(2.3%)	4	(9.3%)	37	(86.0%)
Recreational Building	2	(4.6%)	4	(9.3%)	7	(16.3%)	6	(14.0%)	24	(55.8%)
Religious Building	3	(7.0%)	6	(14.0%)	4	(9.3%)	6	(14.0%)	24	(55.8%)
Retail	8	(18.6%)	5	(11.6%)	3	(7.0%)	11	(25.6%)	16	(37.2%)
Street	4	(9.3%)	3	(7.0%)	1	(2.3%)	1	(2.3%)	34	(79.1%)
Transportation Building	2	(4.6%)	3	(7.0%)	1	(2.3%)	5	(11.6%)	32	(74.4%)
Water Supply / Sewer	5	(11.6%)	3	(7.0%)	1	(2.3%)	2	(4.6%)	32	(74.4%)
Other	4	(9.3%)	0	(0.0%)	1	(2.3%)	5	(11.6%)	33	(76.7%)

Question 11 of the survey defined PRM and asked whether the respondent's company used PRM based upon the definition: "For the purposes of this survey, Project Risk Management is defined as a systematic approach including the following elements: "Proactive identification of project-specific risk factors that may negatively affect cost, schedule, or quality; prioritization based upon an assessment of probability of occurrence and possible impact; and planned responses to each risk item, tailored as appropriate for unique circumstances. Thirty-one respondents to the survey (72.1%) answered "yes" and 12 (27.9%) answered "no." The survey was designed so that respondents answering "yes" to question 11 were directed to question 12; those answering "no" were directed to question 13. No respondent was able to respond to both questions.

Question 12 asked to "Please rate the factors that drive the decision to use PRM in your company/business unit," solicited input on the variables Scope, Schedule, Budget, Owner Requirement, Third Party Requirement, and Other. The Schedule was rated "Very Important" by 76.7% of PRM users, "Important" by 20.0%, and "Somewhat Important" by 3.3%. The Budget was rated "Very Important" by 73.3%, "Important" by 20.0%, and "Somewhat Important" by 6.7%. The Scope was rated "Very Important" by 66.7%, "Important" by 30.0%, and "Somewhat Important" by 3.3%. Owner Requirement was rated "Important" by 41.4%, "Very Important" by 31.0%, "Somewhat Important" by 13.8%, and "Not Important" and "N/A" by 6.9% each. Third Party Requirement was rated "Somewhat Important" by 32.1%, "Important" by 21.4%, "Very Important" by 21.4%, "Not Important by 14.3%, and "N/A" by 10.7%.

Question 13 investigated the "Rate the barriers that weigh against the use of PRM within your company/business unit," and solicited input on the variables Lack of Familiarity, Lack of Training, Lack of Budget, Lack of Time, Inability to See Benefits, and Other. The rating choices were 1) N/A (not applicable), 2) Not Important, 3) Somewhat Important, 4) Important, and 5) Very Important.

Lack of Familiarity was rated "Important" by 50% of non-PRM users, "Somewhat Important" by 20%, and "Very Important," "Not Important," and "N/A" by 10% each. Lack of Training was rated "Important" by 40%, "Very Important" by 30%, "Somewhat Important" by 20%, and "N/A" by 10%. Lack of Time was rated "Important" and

"Somewhat Important" by 30% each, "N/A" by 20%, and "Very Important" and "Not Important" by 10% each. Lack of Budget was rated "Not Important" by 40%, "Somewhat Important" by 30%, and "Very Important," "Important," and "N/A" by 10% each. Inability to See Benefits was rated "Important" and "Somewhat Important" by 27.3% each, "Not Important" and "N/A" by 18.2% each, and "Very Important" by 9.1%.

Discussion of Results

The primary purpose of this research was to provide answers to the following questions:
Question: What is the proportion of GCs that implement PRM? While the survey pool contained companies that are not GCs, a clear majority (79.1%) were general contractors or construction management firms. Question 11 of the survey addressed this directly, revealing that 72.1% of participants use PRM. Question: *What factors motivate the decision to use PRM?* This issue was addressed by Question 12, where PRM users were asked to rate given factors and had an opportunity to provide other factors. Schedule, Budget, and Scope, all internal factors, were rated the highest, with external factors – Owner Requirement and Third-Party Requirement – rated lower. Other factors were not offered. *Question: What are the primary obstacles and impediments to the implementation of PRM?*This issue was addressed by question 13, where non-PRM users were asked to rate given factors and to offer others (none was offered). The highest rated factors were Lack of Training, Lack of Familiarity, and Inability to See Benefits. The high rating of these factors indicates that non-PRM users lack awareness of what PRM is, how to implement it, and why it is beneficial.

Conclusions

Three hypotheses were advanced for the study. The first was that fewer than 50% of companies would use PRM. This issue was refuted by the data that showed PRM use more than 70%. The second hypothesis was that a project's scope, schedule, and budget would be the principal drivers for the decision to use PRM – this hypothesis was supported by the results of Question 12. The third was that lack of familiarity, lack of training, and inability to see the benefits would be the principal barriers to the implementation of PRM – this was supported by the results of question 13.

A secondary purpose of the research was to determine if associations exist between PRM and variables that describe respondent general characteristics, company general characteristics, and types of construction. The variable Position is the only one that is associated with PRM use, a fact that could be explained in that the higher a respondent's position in a company, the more in-depth that person's knowledge of company policies and procedures.

By the above measures, the aims of this research were met. Expected answers to the research questions were obtained, and the broader hypotheses were addressed. That 28 of 29 variables were shown to have no association with PRM should not be taken as a failure, but rather as support for the argument that motives for a company to use PRM are based upon management's decisions regarding project circumstances. The decision is not a function of a respondent or company characteristic or type of construction.

The high ratings of Lack of Training, Lack of Familiarity, and Inability to See Benefits can be interpreted to imply that ignorance of the practices, methodologies, and advantages of PRM among nonusers is the greatest deterrent. Conversely, that knowledge of PRM and its benefits, coupled with a complete understanding of a project's particulars, is the strongest motivator for PRM's use.

Risk is a part of every project. High levels of risk mean diminished chances for project success, and risk management reduces risk and improves the odds of project success (Zwickael and Ahn, 2010). Ultimately, if PRM is to become a standard practice within the construction industry, the data suggest that it will be driven primarily by increased awareness among construction management professionals.

For future research, an in-depth understanding of the drivers for and impediments against PRM use could arise from one-on-one interviews, or from a questionnaire with open-ended questions, inviting participants to freely share their thoughts. However, many risk management programs are proprietary, and it is very likely that participants will be reluctant to share too much information, even with assurances of confidentiality. Since this study was primarily focused on the metro Atlanta area, similar studies in other regions could reveal whether the primary drivers and impediments are particular to this region, or are part of a larger pattern nationwide, or even globally.

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