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Evaluation of Risk Factors Affecting Cost and Time Performance of Civil Engineering Projects in Kwara State

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The construction industry is known for being very poor compared to other industries in the identification, assessment and management of project related risks. Civil engineering projects in particular are riskier due to the nature, complexity and enormous amount of resources required. However, project team usually failed to analyse these risks at beginning of the project, consequently leading to cost and time overrun and unsatisfied client. This paper aimed at evaluating the potential risk factors associated with civil engineering projects with the view to achieving overall project objectives. 31 risk factors were identified from the literature and were used as basis for structuring the questionnaire administered to the Architects, Quantity Surveyors and Engineers in Kwara State. Eighty (80) questionnaires were administered; fifty-one (51) were retrieved and analysed using mean item score for the identified factors. Research findings showed that incomplete design, unstable inflationary trend, delay in progress payment, financial difficulties, improper project planning, inadequate programme planning and foreign exchange rate had greatest impact on civil engineering projects. Whereas factors such as Force majeure, labour dispute and strike and mistakes and discrepancies in contract documents has least impact. The study recommends that project team should identify and quantify project related risk at the initial stage and allocate the risks to party/parties suitable to control them. The significant of this study is that, the identification of the risk factors serves as a watch list of risk that the project team should watch out for, and the evaluation of probability of occurrence and severity will enables the project team determine the level of impact the risk can have on cost and time performance of civil engineering projects.

Keywords: Civil engineering project, Construction industry, Construction project, Cost and time performance, Risk

Introduction

It is virtually not possible to have a risk-free construction project. The inherent nature of construction risks contributes to the inability in achieving the tripartite project objectives of time, cost and quality. Although the construction sector with its myriad of activities arguably is embedded more with risks and uncertainties compared with other industries (Mohammed, 2016), the risks are not dealt with adequately, consequently leading to cost and time overrun (Oyewobi, Ibrahim & Ganiyu, 2012). According to Building and Engineering Standard Method of Measurement 4 (2015), construction project is a conglomerate of building, civil and heavy/industrial engineering work. Considering this, Houghton (2004) defined civil engineering as professional engineering discipline that concerns with the design, construction and maintenance of physical and naturally built environment, such as roads, bridges, dams and buildings. Similarly, Akinmusire and Ologunagba (2016) defined civil engineering project as special project due to its nature, complexity and enormous amount of resources required. This is in line with the view of Barbara (2004) who stated that civil

engineering project requires special engineering skill and a great technical know- how to execute. However, civil engineering projects come into existence in form of structures and buildings of different types, shapes and complexity. Projects of this nature usually has client as the initiator and major financier, while the Civil/Structural Engineer is shouldered with the responsibility of designing and supervision of the project.

Although a plethora of researches (Odeyinka 2006; Amani, 2007; Towner & Baccarini, 2008; Anood, 2014; Mohammed, 2016; Krantikumar *et al., 2016* Amuda-Yusuf *et al.,* 2017 and Andrey *et al.,* 2019) revealed that extensive research has been carried out globally on construction risks, and several risk factors have been identified but mainly focused on examining the impacts of risks with respect to project cost overrun (Joshua & Jagboro 2007), Risk impact on construction cash flow forecast (Odeyinka *et al.,* 2008) and Risk and Price in the Bidding Process of Contractors (Laryea & Hughes, 2011). Some researchers investigated risk management in construction projects holistically (Smith *et al.,* 2014; Isimemen, 2014 & Pawel, 2017). While others focused on risk in Electrical and Mechanical services project such as; risk management for planning and use of building service system (Heimonen *et at.,*2000), Managing building services maintenance risk with prediction theories (Lam, 2006), and risk factors impacting cost and time performance of mechanical and electrical services projects (Amuda-Yusuf *et al.,* 2017). On the flip side, there is a noticeable dearth of research that focuses on impact of risk on performance of civil engineering project. This research seeks to fill this gap in knowledge. The main aim of the study is to explore industry's practitioners' perception on the risk factors affecting cost and time performance of civil engineering projects within the study area with the aim of providing information that will enhance performance and efficient delivery of civil engineering project.

Literature Review

Construction Project Performance

Success of performance is a determinant of the success of construction projects (Akanni, Oke & Akpomiemie 2015). Construction project performance measurement is the process of appraising performance with project objectives in focus (Oke, Ogungbile, Oyewobi &Tengan, 2016). Traditionally, researchers and organisations have focused on the three critical project performance indicators of cost, time and quality (Dainty *et al.,* 2003, Chan & Chan, 2004; Swan & Khalfan, 2007). However, many studies have, also included other performance aspects, such as health and safety (Chan & Chan, 2004), environmental performance (Chan and Chan, 2004; Swan & Khalfan, 2007), customer satisfaction (Chan and Chan, 2004; Collins & Baccarini, 2004), and innovation (Harty, 2008); but the main client project objectives focus more on three factors critical to project success including cost, time and quality (Walker, 2007; Amuda-Yusuf *et al.,* 2017). The study of Chua (1999, cited in Oke *et a.,l* 2016) indicated that time, cost and quality objective together with project satisfaction have a tendency of becoming the most significant keys to measure the complete performance of a project. Furthermore, as remarked by many studies, most project records cost or time overrun during the period of execution (Oke *et al.,* 2016). Time is described according to Amuda-Yusuf *et al,* (2017) as the time from the inception to completion of the project up to the point the project is added into client business. While cost on the other hand is the capital cost including all associated cost of the project. Quality performance measure seeks to ensure that projects achieve the quality standard set out in the contract. Quality of a project can be measured in terms of adherence with stated specification and this can be difficult at times to measures because it is subjective (Samuel, 2017). However, construction project cost and time were the most common performance measurement in project management studies (Walker, 2007; Amuda-Yusuf *et al.,* 2017).

The project cost performance has traditionally been seen as one of the most important aspect of construction project, if the economy of the project is off, the project can rarely be seen as a success (Oke *et al*, 2016). Project cost performance is used to indicate whether the project adhere to the agreed budget (Cheung *et al.*, 2004). Cost is the major considerations throughout the project management life cycle and can be refers to as the most important factor for a successful project delivery (Emmanuel & Anjiba, 2015). A project is successful if it is completed within predetermined sum. Project cost performance is measured in terms of cost overrun i.e. final sum minus initial contract sum divided by the initial contract sum multiplied by 100 (Odusami,2002). Cost overruns can be a source of problems for an unsuccessful project as contractors are criticized for the common occurrence of cost overruns in construction project (Chan & Chan, 2004). Cost overrun is almost associated with all projects in construction industry. Project with percentage cost overrun above 20% is regarded as a poor project in terms of cost performance; project that fall within 10% and 20% is regarded as average project in terms of cost performance, while project with cost overrun of less than 10% is regarded as an outstanding project (Kometa, Olomolaiye & Harris, 1996). Construction projects in developing countries are mostly completed above the initial budget as a result of improper management of project related risk and this require an early assessment and evaluation of potential risk to achieve an effective cost performance of construction project.

The project time performance seeks to assess how well the project adheres to the time schedule during the project execution. Project duration is simply the number of days/weeks/months/years from inception to completion of the project (Oke *et al.*, 2016). Since time can be a critical issue for many clients, project duration is often of primary interest. Projects completed in time is an important indicator of project success and the construction industry is frequently criticised for project delays due to inherent risks present in all construction project (Swan & Khalfan, 2007; Isimemen, 2014). Project schedule or time performance according to Samuel (2017) is calculated in terms of the percentage increase in the actual completion period over initial completion period. i.e. the difference between the actual completion time and planned completion time multiple by 100. The projects with percentage delay less than 10% are regarded as an outstanding in terms of time or schedule performance, those projects that falls between 10% to 20% is regarded as average project while those above 20% is regarded as poor project (Samuel, 2017).

Construction Risk Management

The construction project is unique, dynamic and risky in nature; the construction process is full of uncertainties and is influenced by the productivity of labour, equipment, materials, budget and implementation methods. Construction projects are inherently complex and dynamic, and involving multiple feedback processes (Sterman, 2012; Uher & Loosemore, 2004). It involved a lot of participant - individuals and organisations and their interests may be affected as a result of heterogeneous nature of construction industry.

In countries such as United Kingdom, United States of America and Canada, risk management has become universal management process involving quality of thought, process and action. In contrast, the adoption of the risk management concept in Nigeria has been largely part of the banking and financial sectors of the economy arising from responses to crisis that evolved within the financial sector of the economy in the early 1990s (Kehinde & Falilat, 2015). The outcomes of project are, however, uncertain and there are many parameters and variable over which a company has little or no control (Herman, Getz & Michael, 2003). The successful completion of any project is most times assessed on the basis of three parameters, which constitute risk: time, cost and quality performance (Nworuh

&Nwachukwu, 2004). The benefits of the risk management process include identifying and analyzing risks, and improvement of construction project management processes and effective use of resources.

Identification of Risks Factors in Construction Projects

Several researchers (Odeyinka et *al.,* 2008; El-Sayegh, 2008; Isimemen, 2014; Emmanuel & Anjiba, 2015; Amuda-Yusuf *et al.,* 2017) have studied potential risks in construction projects in developed and developing countries, looking at a range of projects from small to large scale. Various studies have considered risks relating to the three main parties in the construction industry; clients, consultants, and contractors. Others have used sub-categories of related factors, grouping together risks based on their nature. Table 1 presents relevant studies related to the identification of risk in construction projects.

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Risk Classification

Risk classification is defined according to PMI (2014) as a structure that provides an exhaustive process of systematic risk identification to a constant detailing and which match its contribution to the quality and effectiveness to the risk identification process.

Project risk can be classified in various ways depending on the purpose as shown in Table 2. For instance, some risks are generally categorised into internal and external risks, while others are classified in more detail as client risk, financial risk, design risk, contractor risk, material risk, etc. (Dey, & Ogunlana, 2004; Ghosh & Jintanapakanont, 2004; Enshasi & Mosa, 2008; El-Sayegh, 2008; Razakhani, 2012; Goh *et al.,* 2013; Renuka *et al.,* 2014 & Mohammed, 2016)

Table 1: Identification of Risk factors in construction projects.

S/N.	Researchers(s) Work	Identified critical risk factors
1	Prasanta kumar dey,(2002)	Improper project planning, incomplete design, conflict between project participant, statutory clearance and approvals.
2	Ghosh and Jintanapakanont, (2004)	Unclear responsibility, inflation, country economic condition unavailability of funds. Financial failure construction delays.
3	Laryea, (2007)	Contractor's experience, variation, site condition and unknown geological condition, inflation, country economic condition and rules and regulation, unavailability of funds, financial failure and unavailability of required resources.
4	Enhassi and Mosa, (2008)	Poor information dissemination, misunderstanding of client requirement, site condition, inflation, country policy, unavailability of funds, financial failure and unavailability of required resources.
5	Sun and Meng (2009)	Scope and design changes, technology, site condition and unknown geological condition, inflation, country economic condition and rules and regulation, unavailability of funds, financial failure, inadequate managerial skill, lack of coordination between the project team and lack required resources
6	Wang *et al.,* (2004)	Inflation, country economic condition, statutory clearance and approvals, construction delays.
7	Eybpoosh, (2011)	Complexity of design, technology, site condition, inflation, country economic condition and rules and regulation and lack required resources
8	Rezakhani, (2012)	Scope and design changes, technology, unavailability of fund, financial, weather and climatic condition, poor safety procedures.
9	Goh *et al.,* (2013)	Scope and design changes, technology, site condition and unknown geological condition, inadequate managerial skill, lack of coordination between the project team and lack required resources and construction delays.
10	Luka, and Ibrahim (2015)	Tight project schedule, design team experience, inadequate program planning, quality of material and labour performance and productivity.

Table 2: Risk Classification in Construction Projects

Category	Description
Management	This type of risk includes inefficiency of owner supervisors, productivity of labour, productivity of equipment and labour disputes and lead to problems with the productivity on-site, quality assurance, cost control and human resource management. (Berenger *et al.,* 2016; Andrey *et al.,* 2019)
Design	One important requirements to minimise time and cost overrun of construction project is the allocation of sufficient time for design. Design related risk factor include lack of coordination of designs, discrepancy in the design and design team experience (Berenger *et al.,* 2016)
Financial	This category takes into account factors with respect to possible financial difficulties on the project, which may include difficulties in assessing funds, delay in payment, and cash flow problems(Krantikumar *et al., 2016;* Andrey *et al.,* 2019) .
Materials	Use of new and recently developed materials and products is common and some of these materials and products are not analysed over long-term assessments and tests (Krantikumar *et al., 2016*; Paweł, 2017).
Labour- and equipment	Shortage of workface and the existence of unskilled labour are risk factors in relation to Labour issues. (Sweis et al., 2008)
External	These are risks which beyond the control of project team such as government policy, **political** risk, economy instability, social risk and natural risk (Andualem, 2019).

Research Methodology

This study employed survey research techniques and was limited to Kwara State, Nigeria. The target population of the study consists of Archtiects, Quantity Surveyors and Engineers, A purposive sampling technique was adopted based on the fact that the sample frame is large and it would be illogical, financially and technically impossible to collect data from the entire population in the study area (Oke *et al.,* 2016). Based on the review of extant literature, a preliminary list of risk factors in construction project was prepared and a total of 31 risk factors were obtained from six leading categories based on the most often included categories in the relevant literature and the respondents were asked if they consider the risk factors identified as contributing to poor cost and time performance of civil engineering project. 80 respondents were purposively sampled resulting in 51 valid questionaire. Data were collected using a structured questionnaire on 31 previously identified risk factors from preliminary investigations. This study applied the weighted mean score which involves assigning numerical value to respondents' ratings of factors with respect to their probability and severity e.g. Very High, 5 points, High, 4 points, Moderate, 3 points, Low, 2 points and very low 1 point. The data collected were analyzed using Mean response analysis with the aid of SPSS version 20.0 to determine the most ranked risk factors affecting the cost and time performance of civil engineering projects.

Data Analysis and Research Findings

Table 3 indicated that 37.3% of the respondents are from consulting organization, 35.3% are from contracting, while 21.6% are from government ministry/parastatal and very few (5.9%) are from academia. In term of profession, about 26% are Architects, 24% Quantity Surveyors while 51% of the respondents have Engineering background. Majority (74.5%) are Associate members, while 21.6% are Fellow and very few are (3.9%) are probationers. About 15.7% of the respondents have between 11-16 years working expereince, while 23.5% have spent between 16-20 years in the industry and the remaining 60.8% of the respondent have spent more than 20 years in practice. This implies that the information provided by the respondents is reliable considering their level of education, years of experience and knowledge about civil engineering construction projects.

Table 3: Summary of Demographic Information of the Respondents

Categories	Classification	Number	%
Type of Organisation	Consulting	19	37.3
	Contracting	18	35.3
	Government Ministry	11	21.6
	Academia	3	5.9
Academic Qualification	HND	4	7.3
	BSc/ BTech	19	37.3
	MSc	22	43.1
	PhD	6	11.8
Profession	Architect	13	25.5
	Quantity Surveyors	12	23.5
	Engineer	26	51
Professional Qualification	Probationer	2	3.9
	Corporate	38	74.5
	Fellow	11	21.6
Years of Experience	11-15	8	15.7
	16-20	12	23.5
	Above 20	31	60.8
Age of Respondents	41-50	9	17.6
	51-60	11	21.6
	61-70	31	60.8

Source: Field Survey (2018)

The mean probability values for the 31 risk factors (Table 4) ranged between 2.1 ('low') and 4.6 (" high'), the severity scores ranged from 1.2 ('very low') to 4.6 ('high') and the mean impact values ranged between 1.6 ('verylow') and 4.6 ('high). Looking the mean imapct scores , about 9 risk factors have their mean score >4.0 (RF_1 to RF-9). In otherwords, these 9 risk factors are at the top of the ranking. Following that order are RF_10 to R_F 18 with mean scores ranging between (3.1 to 3.9) and (RF_19 to RF_30) mean scores ranged between 2.0 to 2.8 . The rest (RF_29 and RF_31) have mean scores >2.0.

What this result suggests therefore is that respondents perceived the first 9 risks with mean scores ≥ 4.0 as having high impact on cost and time performance of civil engineering projects. On the other hand , 9 other risk factors (RF_10 to RF_18 with mean score $\leq 3.9 \geq 3.0$ are considered by respondents as having medium impact on cost and time performance of civil engineering projects, while RF_19 to RF_30 with mean range $\geq 2.0 \leq 2.8$) has low impact and 2 risk factors (RF_29 and RF_31) with mean scores <2.0 have very low impact.

Based on the breakdown of results in Table 4, incomplete design was ranked highest with impact mean score of 4.57 followed by unstable inflationary trend and delay in progress payment with mean score of 4.47 and 4.37 respectively. Financial difficulties, improper project planning and Inadequate programme planning were ranked next with mean score of 4.35, 4.18 and 4.09 respectively, while foreign exchange rate, delay in material delivery and design team experience were ranked seventh, eighth and ninth with mean score of 4.08, 4.07 and 4.02 respectively.

On the flip side, Force majeure, labour dispute and strike and mistakes and discrepancies in contract documents were the factors ranked least by the respondents with mean score of 1.63, 1.97 and 2.00 respectively.

Table 4: Risk factors

S/N	Risk Factors	Risk Probability	Risk Severity	Risk Impact	Rank
RF_2	Incomplete design	4.57	4.57	4.57	1
RF_4	Unstable inflationary trend	4.51	4.43	4.47	2
RF_6	Delay in progress payment	4.39	4.35	4.37	3
RF_5	Financial difficulties	4.41	4.31	4.35	4
RF_7	Improper project planning	4.29	4.08	4.18	5
RF_1	Inadequate programme planning	4.59	3.61	4.09	6
RF_9	Foreign exchange rate	4.24	3.94	4.08	7
RF_3	Delay in material delivery	4.53	3.67	4.07	8
RF_8	Design team experience	4.25	3.82	4.02	9
RF_10	Variation	4.00	3.98	3.99	10
RF_11	Change in government policy	4.00	3.78	3.88	11
RF_13	Project duration	3.88	3.62	3.75	12
RF_12	Poor information dissemination	3.96	3.44	3.69	13
RF_16	Conflicts between project participants	3.57	3.57	3.57	14
RF_15	Site condition	3.65	3.41	3.52	15
RF_18	Shortage of material	3.55	3.37	3.46	16
RF_17	Scope of the project	3.55	3.17	3.35	17
RF_14	Misunderstanding of client requirement	3.75	2.57	3.10	18
RF_19	Unclear responsibilities	3.47	2.35	2.86	19
RF_21	Contractor's experience	2.96	2.75	2.85	20
RF_22	Availability of material in market	2.86	2.39	2.61	21
RF_20	Discrepancy between the designs	3.19	2.00	2.53	22
RF_25	Poor specification	2.57	2.39	2.48	23
RF_27	Change in material specification and type	2.39	2.39	2.39	24
RF_28	Poor communication and information dissemination between the design team	2.39	2.36	2.36	25
RF_23	Unclear and inadequate information in the drawings	2.59	2.00	2.27	26
RF_26	Inclement weather condition	2.56	1.98	2.25	27
RF_24	Civil disturbance	2.57	1.59	2.02	28
RF_30	Mistakes and discrepancies in contract documents	2.02	2.00	2.00	29
RF_31	Labour dispute and strike	2.01	1.94	1.97	30
RF_29	Force majeure	2.18	1.22	1.63	31

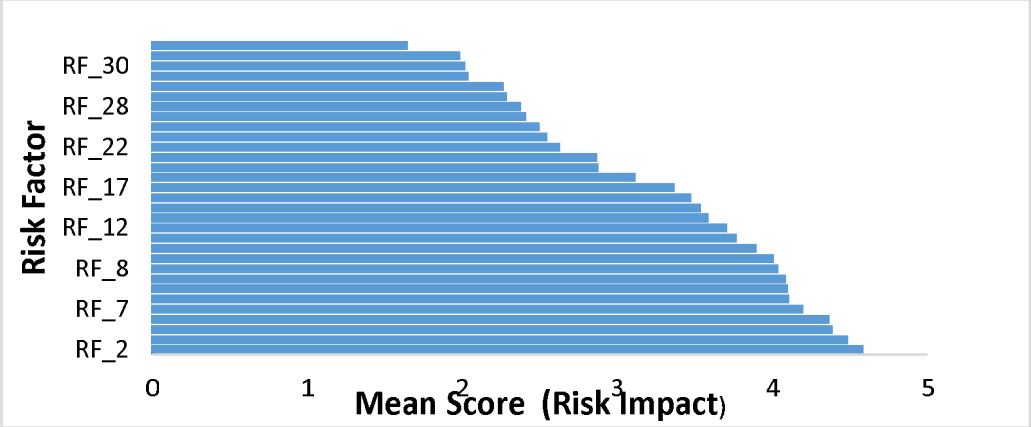

Figure 1: Summary of risk impact cost and time performance of civil engineering projects

The study went further to examine the assessment of the respondents overall rating of risk impact of the 31 items. Mean score was computed as ratio of respondent's total score to maximum score obtainable. Thus, the overall perception of respondents was calculated based on this.

Very low impact if mean<2.0
Low risk impact if mean score ≥2.0 ≤ 2.9
Medium risk impact if mean score ≤3.9 ≥3.0
High risk impact if mean score ≤4.6 ≥4.0
The results in Table 5 show that 50.9% of the respondents sampled in the study rated the 31 risk factors as having high impact on cost and time performance of civil engineering projects, while 23.7.6% rated them as having medium impact, 17.6% low impact and 7.8% very low impact.

Discussion of Findings

The study evaluates the risk factors affecting cost and time performance of civil engineering projects. Based on the research findings, 9 key risks factors were uncovered and 'Incomplete design' was ranked highest. Incomplete design may result from issues such as insufficient time allocated to designer, design team experience, Unclear and inadequate information during briefing; this may lead to Conflicts between project participants, Variation, Mistakes and discrepancies in contract documents and may subsequently lead to poor cost and time performance of civil engineering projects. To avoid incomplete design, the design team need not only to fully understand what the clients want during the project briefing, but also to establish efficient communication scheme among the designer (Luka &Ibrahim, 2015).Closely followed rated factor is 'Unstable inflationary trend' this is not surprising considering the uncertainty nature of Nigerian construction industry coupled with high degree of instability in predicting economic and market condition in Nigeria. There is tendency that the price of material may increase before the completion of the project especially a project with long completion period and will no doubt affect the cost and time performance of civil engineering projects. This factor also reinforced by Lashinde, Ogunsemi and Awodele (2015), who held that the price of construction material mostly depend on foreign component and may lead to high degree of forecasting inflation rate and currency exchange rate which has multiplier effect on infrastructural projects in Nigeria. Closely followed factors ranked were delay in progress payment, financial difficulties, improper project planning and inadequate programme planning. All these factors can be avoided by ensuring payment on time, engage experience project manager and making use of relevant financial forecasting tools.

On other side, Force majeure, labour dispute and strike and mistakes and discrepancies in contract documents were the factors ranked least by the respondents, this indicates that these factors do not have significant effect on cost and time performance of civil engineering projects. Other factors ranked by the respondents based on their perception are between these extreme as shown in Table 4. This shows that the practitioners' perceived incomplete design and inadequate programme planning as the major factors affecting cost and time performance of civil engineering projects which may subsequently lead to cost and time overrun or even abandonment of the projects. The result also educated that when the financial need of the project is not align with programme, it can have serious implication on both cost and time performance of civil engineering project.

Table 5: Overall Perception of respondents on 31 risk factors

	Frequency	Percent
Very low Impact Risk	4	7.8
Low Impact Risk	9	17.6
Medium Impact Risk	12	23.7
High Impact Risk	26	50.9
Total	51	100.0

Conclusion

This study investigated the risk factors affecting cost and time performance of civil engineering projects from the view of construction practitioners in Kwara State. The study established that the risk factors affecting cost and time performance of civil engineering projects are inherent within and outside the project environment. The risks can be categorized as management risk factors, design risk, finance, labour and external risk factors. The study therefore concludes that the major risk factors affecting cost and time performance of civil engineering projects include incomplete design, unstable inflationary trend, delay in progress payment, financial difficulties, improper project planning and Inadequate programme planning, foreign exchange rate, delay in material delivery and design team experience. These factors are very critical to achieve overall project objectives of civil engineering projects. However, the highly rated risk factors in this study may likely be ranked least in other clime; this is possible as a result of heterogeneous nature of construction industry. The practical implication of this study is that, the initial identification of the risk factors serves as a watch list of risk that the project team should watch out for, secondly, the evaluation of probability of occurrence and severity enables the project team to determine the level of impact the risk can have on cost and time performance of civil engineering projects.

This study therefore recommends that the project team should identify and quantify the risks and allocate these risks to a party or parties suitable to control them. Competent contractor who can see the incident of these risks as an important aspect that requires quick attention and who can control them should be awarded the contract.

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