



IMPACT OF RISK MANAGEMENT PRACTICE ON SUCCESS OF ROAD CONSTRUCTION PROJECT

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ABSTRACT

Risk management is defined as process of identification of risk factors, their assessment as well as prioritization of risks along with economical application of resources to minimize and control the occurrence of the risk events. The overall aim of this study is to analyze the practice of risk management along with its impact in urban road construction in Sindhupalchowk district with the perspective of global pandemic of coronavirus disease (COVID-19).

This research is conducted through questionnaire survey to collect the primary data. Response obtained from respondents is rated on a 5 point Likert scale and analyzed through MS Excel. The output regarding the impact is achieved through hypothesis testing using regression analysis between the three independent variables i.e. risk identification, assessment and response and ten success criteria obtained through top ten risk factors.

It is found that risk management practice has significant impact on nine out of ten success criteria. Risk Identification and Assessment is found to have no impact on project within estimated budget however Risk Response strategy has significant impact on project within estimated budget criteria.

Keywords: Risk Management Practice, Risk Identification, Risk Assessment, Risk Response.

1. INTRODUCTION

1.1. Background

Risk management is defined as process of identification of risk factors, their assessment as well as prioritization of risks along with economical application of resources to minimize and control the occurrence of the risk events. Risk management activities is set of coordinated activities that directs an organization in response to the risk events (ISO 31000). The main goal of risk management is to ensure that uncertainties do not deviate the project as per planned output.

Risk management is an ongoing process that allows the project manager to take control of project throughout its life cycle and be prepared for the unseen problems that might occur at any point of project life. Project team needs to establish standard risk management practice from its earliest phase that helps in proper and timely identification of risk and deal with it in an efficient manner. (Petrovic, 2017). This facilitates in clearer understanding of potential risk factors associated with project, detail assessment methods and appropriate response strategy. It also helps to establish well documented historical record that serves as a reference for evaluating future projects.

1.2. Statement of the Problem

The projects belonging to construction industry is characterized as fragmented and complex activities and procedures that possibly brings upon huge risk exposure. Project team needs real time and reliable information regarding project environment for proper identification of risk and consider systematic approach for risk response strategy. Selection of appropriate risk management standards is very essential to manage risk associated with the project and ensure successful completion of project within its desired quality.

Nepal being a landlocked country, road construction as a major mode of transportation is always a matter of utmost importance. After the federalism in Nepal, there are lots of infrastructure works going on rapid pace in all parts of the country. From the entire infrastructure works, construction of the road is very essential for development of the country. The success of these roads projects determine growth and development of area resulting into overall development of the nation. So, to ensure success of these projects, risk management should be effectively implemented resulting into successful development of a community.

The coronavirus (COVID-19) pandemic has become a global challenge for current economy and has huge impact on human life, their society and the global economy as a whole. The characteristics of COVID-19 pandemic has created uncertainty in control over the spread. It is very contagious and challenging to control its spread. Few studies even show that infected people can be asymptomatic as well, limiting the control of COVID-19 through expansion of testing and isolating capacities. It is not known how long vaccine immunity reliably lasts, thus multiple-wave cannot be ignored for long time. The need to comply with social distancing limits the efficiency of construction works on sites. Under such circumstances, to carry out construction activity as well as ensure safe working environment with effective risk management strategy is a big challenge worldwide.

Risk management determines success and failure of the project. In Nepal, most of the construction company does not make any risk management teamwork before the startup of the construction project. The common practice of risk management is thumb method, common sense, sharp judgment and trial and error method which cannot be considered as scientific method of risk management. So, the aim of this study is to analyze the practice of risk management, various risk factors and its impact in urban road construction project of Sindhupalchowk district, Province 3, Nepal along with COVID-19 perspective.

1.3. Research Objectives

✓ To analyze the impact of Risk Management Practice on success of road construction projects.

1.4. Significance of the Study

The study is significant to draw the attention of construction companies/professionals for better evaluation of risk factors and their management for ensuring project's success. The study is also significant for documenting the risk management practice to make it systematic by identifying significant factors and analyze the impact of risk management practice on success of urban road construction projects as well as other construction projects.

2. LITERATURE REVIEW

The construction industry, with the development of science and technology has modified rapidly over the past condition within a decade. Construction firm are facing more risks and uncertainties as compared to past events. The expectation of owner has increased to more and more safe working environment and surety towards deliverables yet contractors are facing high risk event and their occurrence. Risk management has thus, become major highlight of the construction firms for any construction projects. Risk in construction industry is major focus topic in current time as time and cost overrun within the construction projects has become high impact risk factors.

2.1. Global Practice of Risk Management

Petrovic (2017) in his paper "Risk Management in Construction Projects—A Knowledge Management Perspective from Swedish Contractors" found out that Swedish construction industry was fairly unknown about the process of risk management. Analogous methods were implemented though they were not as structured as per theoretical reports. The reason of inadequacy in implementation of risk management were insufficient project duration, capabilities and the work culture. He also concluded the absence of proper documentation of risk management plan.

As per the findings of research, common methods adopted for risk identification were past experience from similar projects, checklists and brainstorming. The most frequent risk response strategies adopted by contractors were risk avoidance then risk mitigation and finally accepting of the risk. Transfer of risks to the other party was quite common among developers. So, the implementation of risk management plan was more or less similar to theoretical concepts regarding risk identification and risk response but risk assessment differed from theoretical concept to a higher degree. The research concluded that the risk management practice adopted were only analogous to the theoretical concept yet systematic and structured process was not being followed by the by Swedish contractors.

Sharaf & Abaelwahab (2015) conducted study with title "Analysis of Risk factor for Highway construction project in Egypt". The research took into account the risk factors that frequently occurred on project life cycle and had significant impact on project completion. According to the study, the major risk factors in highway construction were delay in making decision and land acquisition which have risk factors values of more than 50% and likelihood over 70%. The fuzzy logic model was developed in order to evaluate project

risk. The research found that based on the analysis, the overall risk in highway construction project in Egypt is considered at a medium level and needs to deploy the use of proper risk management.

2.2. Risk Management Practice in Nepal

Mishra & Malik (2017) in their paper "Factor and impact of risk management practices on success of construction project of housing developers, Kathmandu Nepal" concluded that major risk factors in housing construction projects in Kathmandu valley were time overrun risk, project scope risk, financial risk, economic risk, organization risk, leadership risk and safety and health risk.

The research also concluded that independent variables of risk management process (identification of risk, assessment of risk and risk response) had significant impact on eight out of ten project success criteria viz. well defined project scope, compliance to technical requirements, project within planned budget, compliance with the quality standard, project within schedule, controlled financial & economic risk, compliance to safety health and environmental requirements, overcome leadership risks. The independent variables had no impact on two out of ten success criteria viz. overcoming contractual risks and controlled organizational risk. Hence, it was concluded that risk management practice has significant impact in the success of project.

Mishra and Adhikari (2019) in their paper "Urban Road Construction Risk Management", risk factors were investigated to measure the severity and allocation. Based on the contractor's perspective, land acquisition delay-shared with client, strike-avoided, payment problem-accepted by contractor, cash flow problem-transferred to client and corruption-avoided were identified as high risk factors with allocation. Based on client's perspective, most severe risks and their allocation were land acquisition delay-shared with contractor, strike-avoided, payment problem- shared with contractor, cash flow problem-accepted by client and corruption-avoided.

2.3. Coronavirus Disease (COVID-19)

Mishra (2020) in his paper "Maintaining Productivity and Safety during COVID-19" has focused on the importance of safety in construction industry and its influence on productivity of construction project. Corona virus disease first appeared in Hubei, China in January 2020. Due to rapid spreading and lack of vaccine to treat the disease, WHO declared COVID-19 pandemic on 11th March, 2020. This pandemic has affected entire world economics and construction industry is not exceptional. This paper highlights the effects of corona virus disease in work site and suggests following measures of control as:

- ✓ Elimination/ Substitution: Working remotely, Virtual meetings, online trainings.
- ✓ Engineering Control: Isolation, Installation of physical Barriers.
- ✓ Administrative Control: Awareness/ Training, Posture/Sign/Symbol/Signage.
- ✓ PPEs: Safety Gloves/Mask/Googles/Face Shield, Safety Shoes/boots, Apron.

The study concludes that ensuring workplace safe from corona virus disease is a challenge and thus proper preparatory actions must be undertaken before resuming works.

3. METHODOLOGY

The study summarizes various risk factors and ranks them based on risk priority number as per FMEA Model. It also analyzes the impact of risk management practice on success of road construction projects.

3.1. Study Area

The study is conducted at various areas of Sindhupalchowk district, Province 3, Nepal. Many studies have been conducted at central valley on nation however such research have been lacking in other areas. Geology of Sindhupalchowk is characterized by loose soil, frequent large scale landslides and flood like Jure Landslide and Melamchi Flood. With a total death count of 156, Jure landslide was one of the devastating landslides in history of Nepal. The reach of landslide was 1.26 km height and 0.81 km width at the bottom. Along with other destruction of infrastructures, it created a 55 m-high dam in the Sunkoshi River with the potential to cause huge flood and destruction. For construction of roads, hilly region with such land characteristics induces huge amount of risk which is the main region for selecting Sindhupalchowk district as the study area.

The selected road projects are:

- ✓ “Construction of Black Top of Sukute-Chapagaun-Meldanda-Thokarpa-Bhanjyang Road, Sindhupalchowk (Contract No: - DROCHT/3371234/073/74-191)”. The Employer is Ministry of Physical Infrastructure Development, Provincial Road Division Office, Khurkot and the Contractor is Gauriparwati Nirman Sewa Pvt. Ltd. The total length of roadway construction is 10.5 KM with estimated cost of 415.24 million rupees.
- ✓ “Construction of Black Top of Barabise-Thotanaari-Ratamate-Chulthidamar-Ghunde-Om Park Road, Sindhupalchowk (Contract No: - DROCHT/3371234/073/074-192)”. The Employer is Ministry of Physical Infrastructure Development, Provincial Road Division Office, Khurkot and the contractor is Lumbini/ Bandan Bhagwati/ Dragon JV. Total length of roadway to be construction is 8 KM with an estimated cost of 475.35 million rupees.
- ✓ “Construction of Black Top Work of Filmcity Access Road, Dolakha (Contract No: - DROCHT/3371234/073/074-123)”. The Employer is Ministry of Physical Infrastructure Development, Provincial Road Division Office, Khurkot and the Contractor is M/s Lama Construction and Suppliers Pvt. Ltd. The total length of roadway construction is 6 KM with estimated cost of 113.97 million rupees.
- ✓ “Widening and Upgrading of Khagdal-Kukure-Kalleri-Sigarche Road, Sindhupalchowk (Contract No: - DROCHT/3371234/073/74-194)”. The Employer is Ministry of Physical Infrastructure Development, Provincial Road Division Office, Khurkot and the Contractor is Rautaha/Himali Devdhunga/Om Buddha J.V. The total length of roadway construction is 4.5 KM with estimated cost of 153.18 million rupees.

3.2. Study Population

For this research, study population are technical staffs of Ministry of Physical Infrastructure Development, Provincial Road Division Office, Khurkot, consulting firms, engineers, technical staffs of contractor working in road construction projects at Sindhupalchowk district.

3.3. Sample Size

Sample is part of population chosen for the purpose of study. Sample of smaller size may not accurately portray the actual site condition whereas very large sample size though gives better result may be way beyond time and budget constraints. Thus sample size of 30 is chosen for this study based on budget constraints and time available to conduct the research.

3.4. Data Collection

Data is collected from primary and secondary source which are both qualitative and quantitative to analyze the risk management practice adopted at Sindhupalchowk district, Province 3, Nepal.

3.4.1. Primary Data

The primary data for the study was obtained by:

- ✓ Key Informant Interview: To find out the managerial aspects, planning aspects, construction safety plan adopted, project in-charge and project manager will be interviewed.
- ✓ Questionnaire Survey: A simple set of questions will be prepared regarding hazard and risk associated with the construction project.
- ✓ Field Observation: Field visit will be done for visual assessment of the construction procedure.

3.4.2. Secondary Data

The secondary data were collected through detailed engineering project design report, published journals, published articles, different websites and existing legal provisions from concerned regulatory departments.

3.5. Data Analysis

To Analyze The Impact Of Risk Management Practice On Success Road Construction Projects

Regression model of hypothesis testing is adopted to find the impact of risk management practice on success of road construction project in context of Nepal. Independent variable for hypothesis testing is taken as three process of risk management as Risk Identification, Risk Assessment and Risk Response. Dependent variables for hypothesis are the project success criteria based on top ten risk factors obtained through FMEA

model of risk ranking. Finally, regression hypothesis testing is done to analyze the impact of risk management practice on success of construction project.

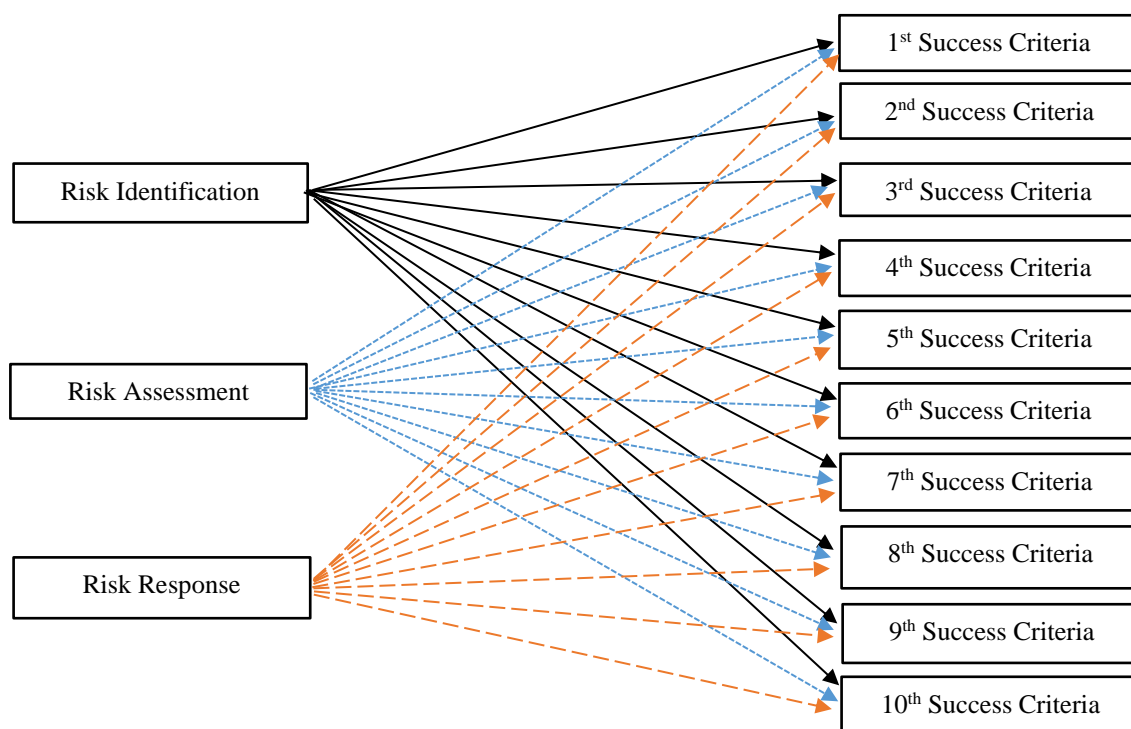


Fig. 1. Research Model for Hypothesis Testing

Setting the Hypothesis

Null Hypothesis: H_0A : There is no impact of Risk Identification on Project Success.
 Alternate Hypothesis: H_1A : There is impact of Risk Identification on Project Success.
 H_{1A1} : There is impact of Risk Identification on 1st Success Criteria.
 H_{1A2} : There is impact of Risk Identification on 2nd Success Criteria.

 H_{1A10} : There is impact of Risk Identification on 10th Success Criteria.

Similarly

Null Hypothesis: H_0B : There is no impact of Risk Assessment on Project Success.
 Alternate Hypothesis: H_1B : There is impact of Risk Assessment on Project Success.
 H_{1B1} : There is impact of Risk Assessment on 1st Success Criteria.
 H_{1B2} : There is impact of Risk Assessment on 2nd Success Criteria.

 H_{1B10} : There is impact of Risk Assessment on 10th Success Criteria.

Finally,

Null Hypothesis: H_0C : There is no impact of Risk Response on Project Success.
 Alternate Hypothesis: H_1C : There is impact of Risk Response on Project Success.
 H_{1C1} : There is impact of Risk Response on 1st Success Criteria.
 H_{1C2} : There is impact of Risk Response on 2nd Success Criteria.

 H_{1C10} : There is impact of Risk Response on 10th Success Criteria.

Reliability Test

Cronbach’s alpha is used to measure the reliability and validity of the response obtained during the questionnaire survey. It is the function of variance of the total score, variance of the item pair and number of question for a given set of data. The value of alpha lies between 0 and 1 where higher value of alpha closer to 1 is more desirable. Value of alpha less than 0.6 shows unreliability of data obtained, value of alpha between 0.7 to 0.8 means acceptable response, value of alpha between 0.8 and 0.9 means good response and value of alpha above 0.9 shows excellence in reliability of data obtained through questionnaire. Formula to calculate Cronbach’s alpha is shown below.

$$\alpha = \frac{K}{K-1} \left(1 - \frac{\sum V_i}{V_t}\right)$$

Where,

K = No. of Questions

V_i = Variance of score on each question

V_t = Total Variance of overall scores on entire set of question

4. RESULTS AND DISCUSSION

This research was conducted through questionnaire survey to analyze the practice of risk management on the urban road construction project at Sindhupalchowk District, Province 3, Nepal. The result obtained from this research concludes that there exist impacts between the risk management practice with success of project. MS Excel was used to analyze the collected data and findings are presented below.

4.1. Impact of Risk Management Practice on Project Success Criteria

Regression model of hypothesis was tested for the response received through questionnaire survey conducted among the technical employees of the projects within the study area to analyze the impact of risk management practice on the success of construction projects in context of Nepal. Three independent variable were chosen for hypothesis as Risk Identification, Assessment and Response. Top ten success criteria were selected as dependent variable based on risk ranking from FMEA table. Response were collected on Likert scale to analyze the impact of independent variables on various project success criteria.

Summary of Hypothesis testing is shown in table below.

Table 1. Impact of Risk Identification on Project Success

S.N.	Hypothesis	F	Sig F	Impact
1	Impact of Risk Identification on well Planned Project Schedule	5.927	0.022	Impact Exists
2	Impact of Risk Identification on Compliance with Safety Health and Environmental Standards	5.425	0.027	Impact Exists
3	Impact of Risk Identification on Project within the Estimated Budget	1.852	0.184	No Impact Exists
4	Impact of Risk Identification on Well assured Financial and Economic Provisions	10.016	0.004	Impact Exists
5	Impact of Risk Identification on Provision made for Force Majeure Situation	11.760	0.002	Impact Exists
6	Impact of Risk Identification on Compliance with Political, Legal and Social Requirements	9.992	0.004	Impact Exists
7	Impact of Risk Identification on Well-structured Organizational Management	11.987	0.002	Impact Exists
8	Impact of Risk Identification on No issue in Contractual Arrangement	9.955	0.004	Impact Exists
9	Impact of Risk Identification on Compliance with the Quality Standards	19.344	0.000	Impact Exists
10	Impact of Risk Identification on Compliance with Technical Design Requirements	15.548	0.000	Impact Exists

Table 2. Impact of Risk Assessment on Project Success

S.N.	Hypothesis	F	Sig F	Impact
1	Impact of Risk Assessment on well Planned Project Schedule	17.326	0.000	Impact Exists
2	Impact of Risk Assessment on Compliance with Safety Health and Environmental Standards	23.290	0.000	Impact Exists
3	Impact of Risk Assessment on Project within the Estimated Budget	2.109	0.158	No Impact Exists
4	Impact of Risk Assessment on Well assured Financial and Economic Provisions	22.075	0.000	Impact Exists
5	Impact of Risk Assessment on Provision made for Force Majeure Situation	54.194	0.000	Impact Exists
6	Impact of Risk Assessment on Compliance with Political, Legal and Social Requirements	25.449	0.000	Impact Exists
7	Impact of Risk Assessment on Well-structured Organizational Management	41.404	0.000	Impact Exists
8	Impact of Risk Assessment on No issue in Contractual Arrangement	40.963	0.000	Impact Exists
9	Impact of Risk Assessment on Compliance with the Quality Standards	30.493	0.000	Impact Exists
10	Impact of Risk Assessment on Compliance with Technical Design Requirements	23.614	0.000	Impact Exists

Table 3. Impact of Risk Response on Project Success

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S.N.	Hypothesis	F	Sig F	Impact
1	Impact of Risk Response on well Planned Project Schedule	19.175	0.000	Impact Exists
2	Impact of Risk Response on Compliance with Safety Health and Environmental Standards	22.928	0.000	Impact Exists
3	Impact of Risk Response on Project within the Estimated Budget	8.323	0.007	Impact Exists
4	Impact of Risk Response on Well assured Financial and Economic Provisions	36.210	0.000	Impact Exists
5	Impact of Risk Response on Provision made for Force Majeure Situation	15.752	0.000	Impact Exists
6	Impact of Risk Response on Compliance with Political, Legal and Social Requirements	23.699	0.000	Impact Exists
7	Impact of Risk Response on Well-structured Organizational Management	17.539	0.000	Impact Exists
8	Impact of Risk Response on No issue in Contractual Arrangement	4.381	0.046	Impact Exists
9	Impact of Risk Response on Compliance with the Quality Standards	28.142	0.000	Impact Exists
10	Impact of Risk Response on Compliance with Technical Design Requirements	23.805	0.000	Impact Exists

5. DISCUSSION ON RESULT OF HYPOTHESIS TESTING

The parameters of Risk management (Risk Identification, Risk Assessment and Risk Response) was found to lay a considerable impact on project success. Numerous risk factors were considered that were likely to occur in the road construction projects and risk were ranked to select top ten risk factors. Success criteria were constructed based on top risk factors and impact was analyzed through regression model of hypothesis testing. Impact of Risk Identification, Risk Assessment and Risk Response on project success criteria were observed in following manner.

- ✓ Risk Identification, Risk Assessment and Risk Response was found to have a significant impact on well planned project schedule. Early identification of inaccurate activity time estimate, improper work breakdown and project schedule and inflexible project schedule helps to take necessary analysis and assessment of risk as well as take appropriate risk response plan. This helps to reduce the consequences of risk on project output ensuring timely completion of project.
- ✓ Risk Identification, Risk Assessment and Risk Response was found to have a significant impact on compliance with safety, health and environmental standard. Risk consequence on human health is quite impactful as compared with other risk factors. It affects both life and property of personnel involved in construction activities. Current condition of global pandemic COVID-19 has put a great challenge on construction activities. Identification of relevant risk factors that are not in compliance with legislative standards highlights the potential risk along with its severity and scale of impact. Adequate assessment and appropriate risk response strategy is quite essential to ensure the success of project.
- ✓ Risk Identification was found to not have significant impact on project within the estimated budget. As long as project proceeds within its allocated budget, there exists no impact on cost overrun risk. Similarly, Risk Assessment was found to play non-significant role in project success related to budget. However, the risk response of the relevant risk factors plays very significant role in the budget of project. Appropriate risk response strategy to carry the progress of project within the planned budget appeared to be very significant for ensuring success of project.
- ✓ Risk Identification, Risk Assessment and Risk Response was found to have a significant impact on well assured financial and economic provisions. Project budget is one of the most important factor that requires constant monitoring and control. To ensure uniform and adequate cash flows as and when needed as well as justify economically is very critical to deliver the output of project successfully. Thus, identification of risks, their assessment and appropriate risk response plan ensures project success based on financial and economic parameters.
- ✓ Risk Identification, Risk Assessment and Risk Response was found to have a significant impact on provisions made for force majeure situation. Geology of Sindhupalchowk district is comprised of loose and fragile rock with constant large scale landslide. Further, huge rainfall often leads to devastating floods during monsoon season. These effects had constantly increased risks of force majeure situation and thus the impact of risk management parameters was found significant on project success.
- ✓ Risk Identification, Risk Assessment and Risk Response was found to have a significant impact on compliance with political, legal and social requirements. Unstable politics, frequently changing

governmental policies, unstable market and social conflict due to difference in interest has brought large impact on construction efficiency, often being reason of work stoppage. Thus, a project, for its success, identification, assessment and response of such risk factors is quite essential.

- ✓ Risk Identification, Risk Assessment and Risk Response was found to have a significant impact on well-structured organizational management. Management of construction organization is a complex job with numerous staff and multiple department. Poor allocation of task and responsibilities, unrealistic project expectation, selection of wrong project, inflexible project plan, adequate resource not available and no proper documentation system leads to failure of project due to organizational management risk. Thus, risk management has high impact on project success.
- ✓ Risk Identification, Risk Assessment and Risk Response was found to have a significant impact on issue on contractual agreement. Non-standard condition of contract, delay in possession of site, lack of time to prepare bids, errors/omission in BOQ, no proper documentation of disputes and claims, lack of insurance, rush bidding and payment problems can be potential risk factors related to contractual issue. Thus, risk management parameters have significant impact on contractual issue.
- ✓ Risk Identification, Risk Assessment and Risk Response was found to have a significant impact on compliance with quality standard. Absence of QAP, untrained manpower, poor material quality and unachievable quality standards were the quality related issue that could risk the success of project. Thus, risk management parameters have significant impact on quality issues.
- ✓ Risk Identification, Risk Assessment and Risk Response was found to have a significant impact on compliance with technical design and specification requirements. Inadequate design information, incorporation of new construction technology, unrealistic specification, likelihood of design changes, difficulties in interaction of design changes, non-conformity with national standards and local specifications, inaccurate quantities are the design risk that has potential to impact the success of project. Thus, risk management parameters have significant impact on compliance with technical design requirements.

To test the reliability of significant risk factors, Cronbach's alpha was calculated to determine the internal consistency.

Table 4 Reliability Statistics for Impact on Project Success Criteria

S.N.	Parameters	No. of Questions (K)	No. of Respondents (N)	Value of Cronbach's Alpha
1	Risk Identification	10	30	0.935
2	Risk Assessment	10	30	0.928
3	Risk Response	10	30	0.947

Here, all the values of alpha for responses related to impact of risk management practice on project success is greater than 0.9. Hence, internal consistency of data is found to be excellent.

6. CONCLUSION AND RECOMMENDATION

All the three independent variables of Risk Management Practice (Risk Identification, Risk Assessment and Risk Response) have significant impact on nine out of ten success criteria as well planned project schedule, compliance with Safety Health and Environmental standards, well assured financial and economic provisions, provision made for force majeure situation, compliance with Political Legal and Social requirements, well-structured organizational management, no issue in contractual agreement, compliance with quality standards and compliance with technical design requirements. For the remaining success criteria, project within estimated budget, Risk Identification and Risk Assessment have no impact whereas Risk Response has significant impact. Hence, even one fails to identify risk, if appropriate Risk Response strategy is selected, success of project can be insured.

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