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# Effects of Risk Management Practices on Project Success in the Construction Industry of Pakistan

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*Abstract*— **This independent study has been conducted to analyse and establish whether any relationship exists between effective risk management practices and project success in the construction industry of Pakistan. The industry under question is marred with inefficiencies both in the public as well as private sector, and success rate of projects are very low. The study aims to investigate, through the use of questionnaires, whether a relationship between effective risk management and improved project success exists., and whether the organisations that undertake risk management processes are able to achieve a better project success rate and, in the process, establish a link between the two. Literature suggests that an effective risk management system comprises of a four-step process which includes risk identification, risk assessment, risk response and overall control of risk. Further study of the literature suggests that the first three elements help enforce and reaffirm the fourth element. Hence, the first three elements were taken as independent variables and a mediation relationship was suggested in the theoretical framework for the fourth element. Questionnaires were adapted from previous research in this area, with country specific factors such as training on risk management issues, policies in this regard and overall understanding and acknowledgement of risk management incorporated into the questionnaires to make it more relevant to the population and chosen sample. This research paper is relevant in today's context since infrastructure projects are at a peak in Pakistan, and the importance of risk management in the overall project planning and execution needs to be determined so that effective measures can be taken to improve the project success ratio in terms of schedule, cost and quality, so that the mediocre performance of construction projects as a whole can be improved and efficiencies can be achieved in this sector of the economy.**

***Keywords— Risk Management; Project Management; Project Success; Construction Industry.***

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## I. Introduction

Construction projects are affected by a number of factors, including human resource quality, design documents, construction management systems, labour quality and availability, availability of finances, supply chain, site location and layout, the project environment and the quality of the equipment available for construction. Additionally, factors beyond human control, such as weather, soil conditions, etc. also play a role in the manner construction projects are conceived and executed. Any construction schedule is greatly affected by these multitudes of factors, and hence, an effective risk assessment and management system is imperative to ensure that the projects initiated are undertaken in a manner that caters to time and cost issues arising out of a lack of risk management. However, risk management within the construction industry in Pakistan is increasingly reliant on intuition, judgement and experience rather than formal knowledge of risk management prevalent in the industry.

## II. Literature Review

Risk is defined as "an uncertain event or condition that, if it occurs, has a positive or negative effect on the project objectives", whereas risk management is defined as the systematic process of identifying, analysing, and responding to project risks. It includes maximising the probability and consequences of positive events and minimising the probability and consequences of adverse events to project objectives, and is divided into six steps: "planning, risk identification, qualitative risk analysis, quantitative risk analysis, risk response planning, and risk monitoring and control" [1]. The positive relationship between risk management and project success has been cited in numerous studies, and evidence suggests that in comparison, projects that employ risk management processes experience a direct impact on project success [2]. Also, when risk management is absent, it means risk identification, analysis of risk severity and planning of appropriate response is missing from overall project planning. Thus, contingencies for risks are missing from schedule and budget making deadlines difficult to meet, causing project delays and failure.

Various studies have been conducted in terms of risk management in the construction industry with varying conclusions. Within the construction industry, risk management and its effectiveness are mainly carried out on the basis of the three factors of experience, judgment and intuition of team members, and there is a lack of use of concrete and formal processes in the construction industry that can contribute to effective risk management. One of the reasons for this is the ignorance of the project teams towards the dynamics involving risk management in construction projects [3]. Furthermore, evidence from Australian construction industry suggests that although many people engaged in the construction processes were aware of and familiar with the requisite risk management procedures, these were rarely employed in the conceptualisation phases of construction projects [4]. A further study identified three factors that contributed towards risk in a project, including; external, internal and project specific [5]. This study concluded that the most critical factors associated with project risks in construction industries were linked to finances, government policies, economic conditions, and project relationships, and maintained that employing risk management and risk mitigation processes reduced the risk factor considerably. One study identified three broad categories of risk associated with construction projects, including project, market and country level risks [6]. Project level risks referred to project activities, such as project design, safety measures at the construction sites, logistic issues, control of resources, quality of project and environmental issues. Market level risks referred to the competitive advantage of other firms in the market, availability of resources and government support to the industry. Country level risks included the macroeconomic stability of the country, including the monetary and fiscal policies of the country which have a direct financial impact on projects, particularly those undertaken over a long term as is the case with construction projects. Yet another study identified multiple risks to construction projects, particularly in the developing world where adherence to policies and procedures is still a matter for concern, and where laws are more lenient. The twenty-eight risks identified in this study were also categorised in country, market and project level categories. Within these categories, country risks were deemed to be most critical, market risks secondary and project risks the least critical in order of severity. Of these, twenty-two were deemed to be risks of a critical nature, particularly in the context of project success. The top eleven risks included influence of government on disputes, interest and inflation rates, termination of joint venture, permit approvals, policies of government, enforcement of justice, corruption, cost overruns, political instability of the country, credit worthiness of local partner and changes in law. The study also concluded that in order to mitigate risks in a construction project, planning and implementation needs to be undertaken at the planning phases on priority basis to ensure that the project success is not compromised [7]. Research has also suggested that risk identification elements need to be incorporated within all the documents of a project, including the statement of work, work breakdown structures, budgeting, scheduling, and the acquisition and execution plans, etc. In this sense, documents that are critical for consideration for risk identification include those listing the mission, objectives and strategy of the project, project justification and cost-effectiveness, project performance and technical specification plans, financial plans, procurement plans, execution plans, cost estimates, environmental impact statements, regulations affecting building projects, and historical safety performance documents [8].

In the risk assessment process, the identified risks are rated as per their likelihood of occurrence, and the potential impact these are likely to have on the project in terms of finances, time and such other resources. The process of risk analysis determines the relationship between the risk occurrence probability and the likely impact of the identified risks. This helps identify the level of risk, after which risk management measures can be considered. Risk management can be done in a number of ways, including contingency planning, using existing assets or making an investment in new resources. Risk levels can be classified as extreme: where an extreme risk requires immediate action due to its potentially devastating impact on the project; high: where a requires action, as it has the potential to have a significantly negative impact to the project, and it cannot be left un-catered to; moderate: where specific responsibility for risk management is allocated within a project; and low: where risk management is not urgent and can be routinely managed. Risk assessment is usually done using qualitative tools and techniques. These have been described as probability and impact analysis tools [9], and/or as likelihood and consequences tools [10]. A risk matrix tool (See Fig. 1) can be of significant help when it comes to risk assessment, given the fact that different projects have different risks and different degrees of tolerance to those risks. Project managers can then mark the threshold above which risks cannot be tolerated and need to be dealt with on an urgent basis.

| | | | | | | |
|---|---|---|---|---|---|---|
| **PROBABILITY** | 5. Almost Certain | | | | | |
| | 4. Likely | | | | | |
| | 3. Moderate | | | | | |
| | 2. Unlikely | | | | | |
| | 1. Rare | | | | | |
| **IMPACT** | | 1. Insignificant | 2. Minor | 3. Moderate | 4. Major | 5. Catastrophic |

Figure 1: Template for Probability-Impact Matrix

Risk management strategies can be employed in a number of ways, ensuring that risk is avoided, reduced, shared or retained. Risk avoidance happens when adequate decisions are taken to eliminate all potential threats reducing the probability of occurrence. In certain cases, calculated risks may be accepted, and high-risk situations can be addressed using the project resources. Risk can also be shared between the stakeholders of a project in the context of profit and loss sharing. This is done to share the impact of a potentially risky situation when it occurs. Risk sharing process also develops opportunities where all strategic partners involved in any project can be engaged within the achievement of strategic goals of the organisation, thereby enhancing the chances of success through a pooling of capabilities and resources. In case of a retained risk, risk is continually monitored during the project time to ensure that it remains dormant and does not emerge as a significant threat to the project [11].

## III. Theoretical Framework

The theoretical framework for this study is based upon various factors that pose risk to the project success in the construction industry [12]. A number of categories for risk have been identified in the context of the construction industry in this study, including technical risks, logistical risks, managerial risks, environmental risks, financial risks, and socio-political risks. All these categories contribute to the development of certain factors that have the potential to impact the probability of risk and the likelihood of its management within any construction project. These factors will be considered in the context of devising questionnaire items for each of the variables. These include: *History*, as risk management is more important in newer projects due to little and no precedence which increases uncertainty; *Management Approach*, which refers to the mindset of the management team and the criticality of a stable and well-informed team; *Staff Quality*, which refers to the experience and expertise of the people working on the project; *Team*

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*Size*, which refers to the size of the team working on the project and the diversity of their qualities and experiences; *Resource Availability*, which has a direct impact on the time, quality and cost of the completed project; *Time Compression*, as inflexibility of schedules may increase risk to a project; and *Complexity*, as the degree of complexity of a project has a direct effect on risks associated with it.

Based on this knowledge and proposed factors in risk management, the following theoretical model has been devised for the purpose of this research (See Fig. 2). This study is assuming three independent variables (IVs), one mediator and one dependent variable (DV). These are illustrated in the model below:

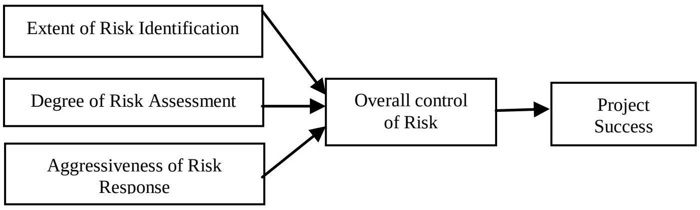


Figure 2: Theoretical Framework Model

The study assumes that the extent to which risk identification is done (IV1), the degree or detail to which correct assessment of these risks is ensured and follows the laid down principles of probability and impact (IV2) and the aggressiveness with which these risks are then addressed and responded to (IV3), in turns helps the overall control of risks (mediator) on construction projects, and this has a direct impact on project success (DV).

Based on this knowledge, with regards to the factors identified in the model developed for this study, the following hypotheses are proposed:

H1: Extent of risk identification increases the chances of project success

H2: The degree of risk assessment, in terms of probability and impact, increases the chances of project success

H3: The aggressiveness of risk response increases the chances of project success

H4: Overall Control of Risk mediates the relationship between extent of risk identification and project success

H5: Overall Control of Risk mediates the relationship between degree of risk assessment and project success

H6: Overall control of Risk mediates the relationship between aggressiveness of risk response and project success.

# IV. Research Methodology

The paper employs quantitative research methodology. A questionnaire adopted from Akintoye and MacLeod was used for data collection. The questionnaire was floated to employees of large construction firms based in Islamabad and Lahore. The respondents held varying positions within their organisations, and thus had varying experiences in the construction industry. The questionnaire addressed issues such as risk perception, risk associated with construction project activities, use of risk assessment and mitigation procedures, such as making people aware of and trained in undertaking adequate risk management techniques, etc. Additionally, IAA Compliance Guide was also referred to in order to develop the questionnaire [13]. As per the theoretical framework, some questions were added to include the factors of company history, management approach quality of workers, their training issues, safety and security, availability of resources etc., so as to ensure that the survey questions reflect these issues in a comprehensive manner. A total of 300 questionnaires were floated in five large construction sector companies through emails and self-administration. A total of 135 completed questionnaires were received, which gives a response rate of 45%, which was considered adequate for the stated purpose of this study. Data analysis has been done using the SPSS software.

# V. Findings

The Demographics of the respondents are displayed in the following tables.

**Table 1: Frequency Table for Age Demographic**

| *Age Bracket* | *Frequency* | *Percent* |
|---|---|---|
| 18-30 Years | 29 | 21.5 |
| 30-40 Years | 42 | 31.1 |
| 40-55 Years | 40 | 29.6 |
| Above 55 Years | 24 | 17.8 |
| Total | 135 | 100 |

**Table 2: Frequency Table for Gender Demographic**

| *Gender* | *Frequency* | *Percent* |
|---|---|---|
| Male | 76 | 56.3 |
| Female | 59 | 43.7 |
| Total | 135 | 100 |

**Table 3: Frequency Table for Qualification Demographic**

| *Qualification* | *Frequency* | *Percent* |
|---|---|---|
| Bachelors | 52 | 38.5 |
| Masters | 66 | 48.9 |
| MPhil/Phd | 17 | 12.6 |
| Total | 135 | 100 |

Table 4 displays the mean, range and standard deviation of all the variables involved in the questionnaire. The N value indicates the total number of respondents. The mean for all 5 variables lies around the mid-point of 3. The standard deviation also reflects that there is not a great deal of spread in the overall opinion of the respondents.

**Table 4: Descriptive Statistics of the variables involved in the questionnaire survey**

| Variables | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| RI_M | 135 | 1.31 | 4.46 | 2.87 | 0.66 |
| RA_M | 135 | 1.40 | 4.50 | 2.99 | 0.59 |
| RR_M | 135 | 1.44 | 4.56 | 3.07 | 0.59 |
| RC_M | 135 | 1.63 | 4.38 | 3.10 | 0.58 |
| PS_M | 135 | 1.71 | 4.57 | 3.23 | 0.62 |

## A. *Reliability and Validity of Data*

Table-5 below shows the results of the reliability test conducted on the questionnaire items and the Cronbach Alpha score for each variable. As reflected in Table-5, all values of the Cronbach Alpha are > 0.7 hence the questionnaire and its results can be taken as reliable.

**Table 5: Cronbach Alpha scores for reliability test of all variables**

| Variable | Cronbach Alpha score |
|---|---|
| Extent of Risk Identification (RI_M) | 0.86 |
| Degree of Risk Assessment (RA_M) | 0.76 |
| Aggressiveness of Risk Response (RR_M) | 0.77 |
| Overall Control of Risk (RC_M) | 0.72 |
| Project Success (PS_M) | 0.72 |

In order to ensure that the demographics are not acting as a moderator between the independent variables and the dependant variable, a one-way Anova test was performed on all the demographics in the data set. The results of the test are shown below in Table 6.

**Table 6: Results of One Way Anova test performed on demographics**

| Demographic | F value | Significance Value |
|---|---|---|
| Age | 1.463 | 0.228 |
| Gender | 0.504 | 0.479 |
| Qualification | 0.402 | 0.670 |

***p <= 0.001, **p <= 0.01, *p <= 0.05, p <= 0.1

From the above test results, it is clearly that there is no relationship between the demographics and the dependant variable. Thus, it can be said that the demographics is not affecting the relationship between independent variables and dependant variable. This further improves the quality of the data set obtained through the questionnaires and increases the overall validity of the research and the research method.

**Table 7: Pearson co-efficient value for co-relation**

| | Age | Gender | Qualification | RI_M | RA_M | RR_M | RC_M | PS_M |
|---|---|---|---|---|---|---|---|---|
| **Age** | 1 | - | - | - | - | - | - | - |
| **Gender** | 0.121 | 1 | - | - | - | - | - | - |
| **Qualification** | 0.003 | 0.141 | 1 | - | - | - | - | - |
| **RI_M** | 0.047 | 0.102 | -0.007 | 1 | - | - | - | - |
| **RA_M** | 0.088 | 0.047 | -0.038 | 0.554 | 1 | - | - | - |
| **RR_M** | 0.059 | -0.042 | -0.134 | 0.336 | 0.448 | 1 | - | - |
| **RC_M** | 0.076 | -0.008 | -0.063 | 0.332 | 0.465 | 0.391 | 1 | - |
| **PS_M** | 0.015 | -0.061 | -0.044 | 0.299 | 0.445 | 0.407 | 0.553 | 1 |

Table-7 shows the results of the co-relation test, with Pearson correlation values mentioned alongside the variables. None of the values are greater than 0.8, no multi-colinearity exist among the variables and we can discard any issue of multi co linearity in our data set. The second thing to note is that the co-relation test suggests the direction of the relationship. The Pearson correlation value between Risk Identification (RI_M) and Project Success (PS_M) is 0.299, denoting that the relationship between these two variables is positive. Similarly, the Pearson correlation value between Risk Assessment (RA_M) and Project Success (PS_M) is 0.445 which is again positive. This also signifies that the relationship between risk assessment and project success is positive and hence, directly proportional. Pearson value between Risk Response (RR_M) and Project Success (PS_M) is again 0.407, also signifying a directly proportional relationship between the two. Of the three independent variables, Risk Assessment has the highest positive co-relation with project success of 0.445, followed by risk response with 0.407 which is then followed by Risk Identification with 0.299. All three independent variables and are strongly positively co-related with project success.

## B. *Regression and Mediated Regression Analysis*

Normality of the data is ensured using the kolmogorov-smirnov and Shapiro-wilk test. Since the test was insignificant, hence data is assumed to be normal. There is no issue of multi co-linearity in the data. This has also been tested in the Co-relation analysis. Since no value of the Pearson coefficient was more than 0. Another assumption is that there is no similarity is consecutive error terms, signifying that auto co-relation does not exist in the data set. To prove that, the Durbin Watson test was conducted on data set. The results of the test are shown in Table 8.

**Table 8: Results of the Durbin Watson test**

| Model | R | R squared | Adjusted R squared | Std. Error | Durbin Watson |
|---|---|---|---|---|---|
| 1 | 0.503 | 0.253 | 0.236 | 0.54 | 1.862 |

The value for the Durbin Watson test is 1.862. This suggests that there is a very weak issue of auto-correlation present in the data set which can be neglected which means that we can assume there is no issue of auto correlation in the data. In order to test the homoscedasticity, the white test was conducted. Since the result of the white test is also significant, homoscedasticity is prevalent in the model. Hence, all four assumption of the linear regression model have been met and we can now proceed with the regression.

**Table 9: Results of Simple Regression Analysis**

| Model | Unstandardized Coefficients | | Standard Beta | t | Sig |
|---|---|---|---|---|---|
| | B | Std. Error | | | |
| (Constant) | 1.341 | 0.292 | | 4.590 | 0.000 |
| RI_M | 0.040 | 0.085 | 0.043 | 0.472 | 0.638 |
| RA_M | 0.323 | 0.101 | 0.307 | 3.188 | 0.002 |
| RR_M | 0.263 | 0.088 | 0.255 | 2.998 | 0.003 |

Table 9 above shows the results of simple linear regression without mediation. According to the regression equation established, Yo = Bo + B1X1. When all factors are constant at zero, the project success is 1.341. The results also show that when all other independent variables are taken constant at zero, one unit increase in risk identification leads to 0.040 unit increase in project success, showing positive relationship with project success. However, the significance level for the relationship between risk identification and project success is below the significance level, hence the strength of the relationship is not established. A one unit change in Risk Assessment leads to a 0.23 unit increase in Project Success. This means that the relationship between risk assessment and project success is positive and the significance level of the relationship is also 0.002 which lies within the significance level. Hence, a positive relationship between risk assessment and project success has been established and the strength of the relationship is strong. Finally, one unit change in Risk Response leads to a 0.263 unit increase in project success. This means that there is a positive relationship between risk response and project success and since the significance value for this relationship is 0.003, it is within the significance range hence this relationship has been established and the strength of this relationship is also high. Value of R- square for the above regression model is 0.253. A value of 0.253 is acceptable since the behaviour under study is human behaviour which consists of a great deal of variability.

**Table 10: Results of Preacher and Hayes mediation analysis between**

| Variable | Project Success (DV) | |
|---|---|---|
| | **Coefficient** | **Significance** |
| RI_M | 0.1203 | 0.0919 |
| RC_M | 0.5403 | 0 |
| RA_M | 0.2522 | 0.003 |
| RC_M | 0.4679 | 0 |
| RR_M | 0.2315 | 0.0038 |
| RC_M | 0.4926 | 0 |

Based on Preacher and Hayes mediation model Table 10, the coefficient value for the relationship between Risk Identification (IV1) and Project Success (DV) is 0.1203 and it is significant. The value of coefficient for the relationship between control of risk (Mediator) and project success (DV) is 0.5403 and it is also significant. Similarly, when the Preacher and Hayes mediation model is repeated for the mediation model of Risk Assessment with Project Success and Overall control of risk as mediator, the coefficient for relationship between risk assessment (IV2) and project success (DV) is 0.2522 and it is significant. Coefficient value for relationship between mediator and Project Success (Dependant variable) is 0.4679 and it is also significant. Hence, there is mediation of control of risk in the relationship between risk assessment and project success. The relationship is significant. For the third and last mediation model where the relationship between risk response and project success is being mediated by overall control of risk, the Preacher and Hayes mediation model suggests that coefficient for relationship between Risk Response (IV3) and project success (DV) is 0.2315 and it is significant. Similarly, coefficient for relationship between mediator and project success is 0.4926 and it is also significant. This signifies yet again that overall control of risk acts as a mediator between risk response and project success and this mediation relationship is significant.

This research was conducted with the aim of investigating whether risk management practices have any effect on the overall project success in the construction industry of Pakistan. Except the first hypothesis, all other hypotheses were accepted.

| | |
|---|---|
| H1: Extent of Risk Identification has a significant relationship with Project Success | Rejected |
| Hypothesis H2: Degree of Risk Assessment has a significant relationship with Project Success | Accepted |
| H3: Aggressiveness of Risk Response has a significant relationship with Project Success | Accepted |
| H4: Overall Control of Risk mediates the relationship between extent of risk identification and project success is accepted. | Accepted |
| H5: Overall Control of Risk mediates the relationship between degree of risk assessment and project success is accepted. | Accepted |
| H6: Overall control of Risk mediates the relationship between aggressiveness of risk response and project success accepted. | Accepted |

# VI. Conclusion and Recommendations

This research has reinvigorated the concepts of risk management and solidified the benefits that can be reaped from an effective risk management system. The link between risk management and savings in terms of time and cost is well-documented, but has been proven in a projectized environment as well in the Pakistani construction industry. With this research, the theory has been reinforced that an effective risk management system must comprise of a method of risk identification, a strategy for risk assessment and a mechanism for prioritizing risk response. The research also highlighted the need for effective control of risk and how success of a project is not possible without a strong control over the project risks. While there were generally positive tones in terms of risk management and project success in this research, there were some deviations from theory as well in miniscule form that need to be addressed and documented. Each industry and the environment in which the industry operates brings with it a new take and a fresh understanding of previously mundane concepts. The feedback and data collected from respondents also signals towards a misleading trend of merely collecting information without acting on it. Emphasis on procedures and document control is necessary but the purpose of the exercise must also be remembered. The respondents disagreed with the idea of risk identification having a direct impact on project success because in the environment in which they operate, the tools being used to ensure risk identification are superficial and do not target the core problem. It is a lesson to be learnt from this research that risk identification can only be made possible if the people involved in the process bring together their collective wisdom and paperwork or procedures alone will not be sufficient. This research also proves that risk management is a reality that needs to be understood and respected rather than discarded and doubted. There are savings and chances of improved efficiencies for whoever is looking to adopt these strategies into their work methodology.

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