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Assessing and Controlling Risks During Construction Phase of Multi-Storey Residential Apartments

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Abstract: ***Risk undertakes vital part in the accomplishment of construction project. In managing risk, distinguishing of risk factors is very critical. The aim of this research is to recognize and assess the current risks and vulnerabilities during the construction phase of multi-storey residential apartments through comprehensive literature survey. Data was collected utilizing checklist survey from distinctive building construction projects in Lahore. Total 35 risks were associated with construction projects classified in four categories such as scaffold, excavation, falling from height and ladders. A research result demonstrates that both owners and contractors do not systematically apply risk management practices, bringing about negative outcomes for the project's performance. The fundamental hazards occur amid execution of the project were related to scaffold, fall into Excavation, Collapse of excavation and Falling from height. This study proposed that the organizations need to keep up legitimate documentation procedure which should be a solution to all hazards that are liable to occur during the construction phase of the project. The contractors ought to focus their strategy to alleviate top risk impacts and build their possibilities of success.***

Keywords: ***Risk, Risk Assessment, Risk Management, construction***

I. INTRODUCTION

Hazard administration is an indispensable and basic matter to venture directors if didn't legally oversee, risks may bring undertaking disappointment [1]. The risk is thought to be a main consideration that impacts venture achievement and project risk management. Risk management is an indispensable and basic matter to project management; If not properly managed, risks may bring out project failure [1]. Risk is considered to be a main consideration that impacts project success and project risk management is an important process in any capital project, especially construction projects [2]. Risk assessment helps in estimating potential effects of risk and in setting on choice in regards which risk holding and which risk transferring to different parties. Both quantitative and qualitative methods are accessible for risk management.

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The quantitative methods depend on the likelihood distribution of risks and may give more precise results than the qualitative methods if the available information is strong and dependable. On the other hand qualitative methods rely on personal judgment and past experiences of the analyst and the outcomes may differ from person to person. Hence the quantitative method should be given priority if both choices are available [5].

Construction projects are constantly exceptional and risk raise from various different sources. Construction projects are characteristically intricate element and including numerous input forms. A considerable measure of members, individual and organizations are effectively included in the construction projects and their intrigues may be emphatically or contrarily influenced as a result of the project execution or project completion. Different participants with different experience and skills ordinarily have different interests and expectations. This regularly makes issues and disarray for even the most experienced project managers and contractors [6].

II. MATERIALS AND METHODS

In this thesis, general focus had been made on the general ideas of risk management. Risk identification had been done with the study of literature. A questionnaire was developed by going through literature and books on risk management in construction projects. A risk assessment had been evaluated by using SPSS. A discussion was done with persons working on building construction projects in Lahore to identify and assess the risks associated with construction projects. The research result was acquired by conducting a survey among professionals of diverse construction organizations.

2.1. Benefits with Risk Management

The risk management process should be persisting created during the whole project .Along these lines risks will be found and managed all through the phases [14]. The advantages of risk management are not reserved for the project itself as well as for the characters included. The principle motivating forces are clearly understood and consciousness of potential risks in the project. In other words, risk management adds to a superior perspective of conceivable results coming about because of unmanaged risks and how to avoid them [12].

2.2 Factors Effective Risk

Several factors expose a project to normal, then higher risks. Following are the factors:

History: Newer projects are more inclined to risk as they are not the same from the other projects. If a project of comparable nature has been carried out many times before then the probability of success with the current projects is moreover improved [13].

Management stability: Management stability implies the entire administration has the same objective and target for any undertaking along these lines leading successful accomplishment of goals. If the management is unstable then it can prompt implausible also, unfeasible schedule of the project and inefficient utilization of sources [13].

Staff expertise: For any project, if the manpower is sufficiently experienced and having diverse ability, the value, expense and different goals can be accomplished [13].

Team size: For large staff of any project, there are more risks of event of issues due to the miscommunication [13].

Resource availability: If the project is accessible with a decent measure of assets, then the reaction to the issue will be great. For example easy availability of money makes securing human, equipment and material resources easy on as required premise. However an abundance of resources does not provide guarantees against risks, all it does is to equip the project team with the strategies to react to risk [13].

Time compression: If the task schedule is profoundly compacted there are more risks of occurrence of dangers in the project. At the point when additional time is accessible for the task, then it can be adapted up by decreasing risk effect on the undertaking [13].

Complexity: If the project is exceptionally intricate there are more risks for in the event of an issue in the project [13].

2.3. Risk Management Process

2.3.1. Risk Identifications

Risk management always starts with the identification which may be viewed as the most important phase of the risk management process Its purpose is to prepare a list of important risks for a specific project. To prepare this list it is the first important to research the potential source of risk, unfavourable occasions that incorporate risk and the unfavourable impact of an undesirable situation. Risk identification extraordinarily relies on the manager's experience. If his experience with specific strategies and techniques of risk identification is good, then he will keep on utilizing them, whereas bad experience prompts to avoiding methodologies arranged earlier [14].

A risk identification method generally includes brainstorming, expert analysis, risk checklists modelling and analyzing project plan and different scenarios. Additionally, sources of risk or uncertainly and sources of known unknown should be listed [9].

2.3.2 Risk assessment

2.3.3Qualitative analysis

The group of qualitative risk analysis methods does not work on numerical information displaying results in the structure of depictions, suggestions and ordinal scores where risk evaluation is associated with qualitative description and determination of qualitative scale for impact and likelihood of the risk outcomes [7].

Qualitative strategies can be arrangements of risks, risk maps or risk ranking .These techniques organize risks for resulting further analysis or action by assessing and brushing their probability of occurrence and impact. The risk is surveyed in more sensible terms, such as high, medium; low relies on the gathered assessments and risk versatility limits in the organization and collected opinions [8].

Table 2 Probability and Impact of Risk [4]

Possibility of Occurrence	Probability	Type and Level of Risk Impact	Impact Factor
Very high chance	90%	When maximum impact on cost, scope and time	0.9
High chance	75%	When High impact on scope, medium impact on time and lesser impact on cost	0.6
Greatest chance	60%	when High impact on time, Medium impact on scope and lesser impact on cost	0.3
Possible	45%		
Likely	30%	High impact on cost of the project, medium impact on time and lesser impact on scope	0.1
Unlikely	15%		

The Main Qualitative Analysis Techniques Are

Brainstorming, Effect diagram, Checklists, Event tree analysis, Risk breakdown matrix, Risk information, Quality assessment [8].

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2.3.2 Quantitative analysis

Quantitative method required a considerable measure of work for the analysis to be performed. The exertion should be weighed against the advantages and results from the selected system for instant smaller project may in some cases required, just identification and taking action on the identified risk while large projects required all the more inside and out analysis[. PMI 2009 defines the quantitative strategies, evaluate the effect of a risk in a project .They are more suitable for medium and large projects because of the quantity of obliged resources, for example skilled persons [11].

2.3.3. The Main Quantitative Analysis Techniques Are

Decision tree analysis, Expert judgment, Fault tree analysis, Likelihood approach, Tornado diagram, Monte Carlo simulation [11]. A project recreation is carried out utilizing a model to show the potential effect of different level of uncertainties on project objectives. Monte Carlo simulation is generally used for this analysis. It can evaluate the impact of uncertainties and risks on project budget and schedule. It simulates the full framework ordinarily each time randomly choosing a value for every component of its likelihood distribution. It uses three point estimation most likely, worst case and best case duration for each task in time management [13].

2.3.4Risk Response

The third step of the risk management process describes that what move should be made toward the identified risks and threats. The response technique and methodology chosen rely on upon the sort of risk concerned. Another necessity is that the risk needs to have a supervisor to monitor the improvement of the response which will be agrees by the persons included in risk response process [10].

2.3.5. Risk Reduction:

By having an overview over the entire project, it is easy to distinguish issues, which brought about the harm. So as to decrease the level of risk the uncovered areas should be changed, one of the methods for reducing the risk introduction is to share with other parties. For instance, the general contractor will endeavour to decrease his risk exposure to pay liquidated damages for late completion by imposing liquidated damages clauses in sub-contractor agreement [3].

Those risks which should be reduce can likewise be imparted with parties that have more suitable resources and knowledge about the results Sharing can likewise be an alternative by participating with different parties . Along these lines, one project team can exploit of another's resources and experience. It is an approach to impart obligation concerning risk in the project [3].

2.3.6. Retention

When a risk cannot be transferred or avoided a strategic distance from, the best arrangement is to retain the risk. For this situation the risk must be controlled in mind, the end goal to minimize the impact of its occurrences. Retention can likewise be a choice when different solutions are uneconomical [3].

2.3.7. RISK AVOIDANCE:

If the risk is classified as bringing negative outcomes to the entire project, it is of significance to review the project's objective. In other words if the risk has critical effect on the project the best solution is to stay away from it by changing the scope of the project or most exceedingly worst situation cancel it [2]. PMI defines that there are numerous potential risks that a project can be presented to and which can affect its prosperity. This is the reason risk management is required in the initial phase of the project, as opposed to managing with the damage after the occurrence of the risk [4].

2.3.8. Risk Transfer:

Transferring risk includes discovering any other party who is willing to accept responsibility for its management and who will bear the liability of the risk if it occurs. Transferring a risk does not dispense with it the risk still exists anyway, it is owned by another party. Transferring risk can be a successful approach to manage financial related risk exposure. The point is to ensure the risk is owned and managed by another party best able to deal with it successfully [13].

2.3.9 Risk Monitoring

The final step of the risk management process is indispensable since all data about the identified risk is gathered and observed [10]. PMI defines The continuous supervision over the risk management process helps to find new risks, stay informed concerning identified risks and dispense with past risks from the risk evaluation and project [4].

III. RESULTS AND DISCUSSIONS

A total of 39 sites from different sectors across Lahore were analyzed to obtain information about the risks during the construction phase, Number of employees, Qualification of employees and total experience of employees through a checklist.

Fig. 1 describes the scale-wise distribution of organizations analyzed. Out of 96 organizations analyzed, 46 were small scale, 20 were medium scale, and 30 organizations were large scale.

Fig. 2 gives the employment details of the analysed organizations. Among the visited organizations 44% had less than 25 employees, 19% had 26-50 employees, 6% had 51-100 employees and 31% had > 100 employees.

Fig. 3 shows that majority (62%) of the respondent had working experience of 1 to 4 years in the construction industry while 23% of the respondents had working experience of 5-10 year, 3% of the respondents had working experience of 11-15 years and 12% respondents had working experience of more than 15 years.

Fig. 4 shows that 8% of the respondent had an MSc Engineering degree, 38% had BSc Engineering degree, 43% had BS Civil Technology degree, and 11% had an Associate engineer Diploma.

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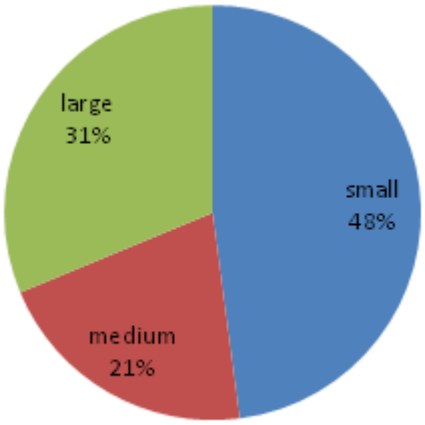

Fig. 1 Distribution of Organizations According to Scale

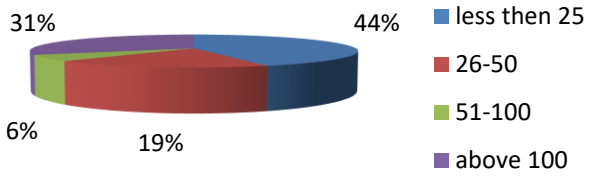

Fig. 2 Numbers of Employees

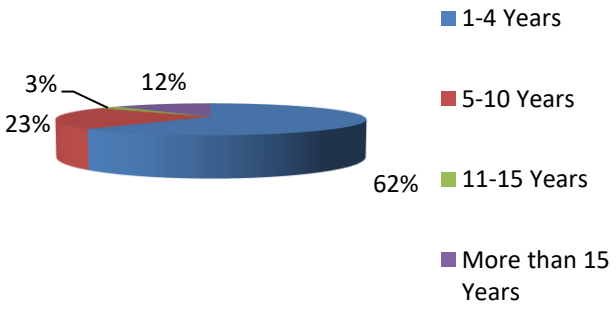

Fig. 3 Rate of Responder Based on Experience

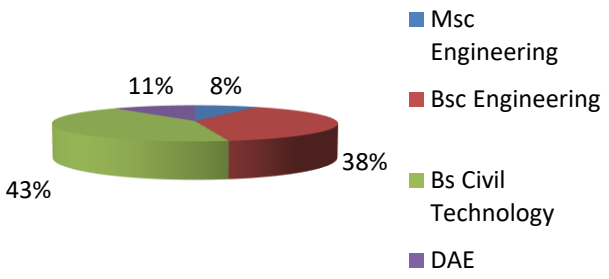

Fig 4 Shows Qualification of Respondent

3.1. Hazards Control Measures of Scaffolding, Temporary Platforms and Works Stands

There are distinctive elements, which are responsible to create the hazards during construction phase of multi-storey building apartments. The impact of these hazards can be minimized by utilizing the hazard control measures. A great majority 85.3% of respondent reported the load-bearing couplers utilized where appropriate. A fair majority 69.3% reported that double guard rails and toe boards, or other suitable protection used at every edge, to prevent people and materials falling. More than 50 present 57.3% of the respondent reported that additional protection such as wire mesh brick guards utilized where appropriate. A fair majority 65.3% pointed out that incomplete section of the scaffold marked with suitable warning notices. More than 55 present 58.7% respondent pointed out effective barriers or cautioning notification in place to stop people utilizing an incomplete scaffold, e.g. where working platforms are not completely boarded. A fair majority 62.7% pointed out that results of inspection recorded. Furthermore a fair majority 65.3% of the respondent pointed out that the scaffold edge protection provided to stop people or material falling.

3.2Hazards Control Measure of Excavation Work

Great majority 76% of respondent reports that safe access into the excavation such as a sufficiently long secured ladder. Fair majority 60% reports that excavation affects the stability of neighbouring structures or services. Great majority 81.3% reports that barriers or other protection provide to stop people and vehicles falling in the excavated area. Furthermore, 86.7% of respondent reported that the excavation regularly inspected by a skilled person.

3.3 Hazards Control Measure of Protection against Falling and Collapsing

A great majority of 82.7% reports that Man-holes secured with clearly marked and fixed covers to avoid falls. A fair majority of 66.7% reports that areas without railings differentiated off with proper barriers. A great majority 73.3% reports that openings in floor secured with firm and marked covers. Furthermore, 74.7% respondent reports that open sides of floors, lift openings and so on secured with triple-part side protection; handrail, mid rail, and toe board.

3.4 Hazards Control Measure of Walkways, Access Routes, Stairs and Ladders

A fair majority 66.7% respondent reports that Handrails and mid rails provide to prevent falls of persons when the falling distance is more than 0.5 m. 60% reported that no opening which may cause falling. Furthermore, fair majority of 72% reports that proper roofing in the entrance of the building to stop falling of objects.

IV. DISCUSSION

In this chapter the research questionnaire will be answered on the basis of survey with a comparison to the theory.

4.1. Scaffolding, Temporary Platforms and Work Stands

The surveys show that respondents identified as so much work is embraced from a scaffold platform, it is crucial that they are safe when erected and afterward kept up in a protected way, until extreme dismantle and removal.

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4.2. Competency

The surveys show that respondents identified the competency of the individual erecting the scaffold is paramount. Erroneously erected scaffold could fall, bringing about injury to those working on it. On the off chance that the fittings were inaccurately fixed or fitted the resulting displacement could bring about someone to fall off.

4.3. General Access Scaffold

The surveys show that respondents identified the most important main hazard to the worker on site is falling from or through the scaffold. The provision of guard rails is fundamental. The top guard rail must be at least 910mm over the edge from which any person is Obligated to fall; generally this will be situated at 1000mm (1m) high by most scaffolds. Note: this measurement of 1m ties in with most restrictive scaffold systems. To avert falls whilst kneeling an intermediate guard rail must be provided whereby there shall not be an unprotected crevice surpassing 470mm between any guard rail, toe board, barrier or any similar means of protection

To avert injury to those passing below a scaffold toe board or other comparative method for insurance should not be less than 150mm high to avoid loose material, etc., being removed and falling onto any person underneath. Typically this will be accomplished by placing a scaffold board on edge.

4.4. Alternative Scaffolds

Scaffold towers offer a distinct option for general access scaffolds for short-term work. Customarily they were made of scaffold parts and the same standards apply with respect to scaffolding. Sometimes the towers need to be mobile and they can be fitted with castors which must have the facility to be locked when stationary and the tower is in use.

4.5. Excavations

The surveys show that respondents identified the most important main hazards from excavations are falling in and collapse of the sides which could both result in death.

4.6. Falls Into Excavations

Risk assessment and hierarchy of importance of anticipation are fundamental when considering falls in the context of excavations. There is without a doubt the necessity to provide edge protection where a person could fall more than two meters. Even underneath two meters there is a risk of injury from the fall. Additional risks should be considered when carrying out the risk assessment. A higher level of consideration is required near public areas because of conceivable interest, especially with children. Customary guard rail heights may be acceptable for adults, but not for children who may slip underneath, along these lines fencing is more appropriate.

4.7. Collapse of excavations

The surveys show that respondents identified if a hole is dug in the ground this action creates an imbalance in the ground pressure. Contingent on the ground strata and length of time left open, the sides of the excavation will eventually collapse, except for some rock strata.

The risk to the operative in the excavation can be fatal. Should they be covered, then they will not be able to breathe and regardless of the possibility that their mouth is in the open, the heaviness of soil on their body will imply that once they breathe out the diaphragm will stay collapsed, and if not able to breathe in then death will take after rapidly. It is crucial that the arrangement of work prevents this potential risk. Conventional excavation support systems utilized trench sheets and screw props, which included the operative having to enter the excavation before it was safe. The risk assessment process should distinguish the deficiencies of this method and lead to systems of support that are remote from the excavation, i.e. box systems. There are several box systems available to suit different types of work method, including designated manhole boxes. A newer alternative is the use of Trenchless Technology. Any support system should be intended to ensure it is satisfactory for the reasonable force loads, including the excavated material and plant movements. The safety of the excavation worker is paramount.

4.8. Falling from height

The surveys show that respondents identified all the activities in construction are possible hazardous; however, the biggest problem is falling from height. This has always been the fundamental accident causation and has remained genuinely consistent. Practically so much work is attempted at height that this is certain, though not acceptable.

The hazard from falling is the most serious risk to be experienced by any person on a construction activity. The potential for harm gets to be more prominent as the height of the fall increments. There is a prerequisite under the Construction hazards Regulations to execute particular control measures, for example guard rails, wherever there is a danger of any person falling from a height greater than 2 meters. It is intriguing to note that labours have the most accidents but, as they represent a substantial rate of the workforce, there may not be a connection with the quantity of accidents. In any case, in the event that you consider that majority of the trades in the construction project work at height this does balance the figures slightly.

4.9. Ladders

The surveys show that respondents identified the majority access from one level then on to the next in the construction project is by ladder. This gives the opportunity for a variety of hazards which incorporate erroneous specification (i.e. the ladder is too long, too short, not strong enough for the task), poor maintenance (ladders can fall into disrepair and rungs can be loose or warped), poor use (the ladder is not secured properly, etc.) and poor placement (traffic could cause the ladder to be knocked), all of which could bring about serious injury.

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V. CONCLUSION

While most of the previous research work has concentrated on a few parts of construction risk management, this Research attempted to distinguish key risk factors connected with the construction phase of multi-storey building apartments. Risk management procedure is seldom utilized by the largest organizations in construction projects. However the respondents have uncovered that these practices cause the problem of project delays. The risk management system is not utilized because of less knowledge and awareness among the construction project. Additionally, contractors should focus their strategy to mitigate top risk impacts and build their chances of success. Risk management techniques ought to be applied to any construction project at the starting phase of the project to get more extreme advantages of the technique. Hence, the organizations need to keep up legitimate documentation procedure which should be a solution to all hazards that are liable to occur during the construction phase of the project.

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