

Analysis of Risk Management Factors in Residential Renovation Work and their Mitigation

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Abstract— Many people renovate their homes to give them a new look and make them more energy efficient. Renovating residential buildings is a difficult job to design, implement and construct there are many risks. The sector is vulnerable to several technical, socio-political, and business risks. Track record dealing with these risks is not very good in the renovation industry. People working in the industry face many failures, such as failure to meet operational and quality requirements, escalating costs, and indefinite delays in completing projects. Residential renovation work largely done by low and medium level of construction companies and firms. The aim of this work is to gain in depth knowledge of risk management and investigate the different risks, their importance, and their impact on the project objectives. In this study, the chosen method for risk management is the distribution of questionnaires to 05 renovation project in Delhi NCR in context of site execution team. Qualitative risk analysis used for analyzing the data collected from Questionnaire, the probability-impact matrix was plotted, we mark high risks from the matrix. Risk management practices of selected companies in Delhi NCR is low to average. Risk management processes that identify, transfer, and mitigate risks are essential to the success of a project.

Index Terms— Risk Management, Renovation Projects, Risk Analysis.

I. INTRODUCTION

Home remodeling is a no-brainer for people who love a challenge and a beautiful home! Renovating your home will also pay off, especially if you are planning to live in the property once it's finished. However, like all residential renovation projects, renovation involves a lot of designing, hard work, and money. However, it's an excellent way to live in an old house in modernizing way. Renovating, remodeling, or advancement of a building is a process of renovating or addition to a building. Home renovation can include projects that alter an existing home's interior (such as electrical and plumbing), the exterior (masonry, stone, side, roof), or other renovations. Home improvement plans can be done for a variety of reasons. Personal preference and comfort, maintenance, or repair work, expand your home by adding room/space, as an energy saving measure or to improve security [29].

Although "home improvement" often refers to construction projects that alter the structure of an existing home, it also includes improvements to outdoor structures such as lawns, gardens, huts, and garages. It also includes maintenance, repair, and general support activities. Home improvement projects typically have one or more of the following goals: Comfortable Space, Maintenance, Add-On in living space, Conservation of energy, Preparedness of Safety.

Market of Home Renovation in India

India was the headmost country to launch an extensive house renovation program, and by 2007 home improvement had become a \$100 billion industry. Home renovation is a huge industry with over \$1 trillion in annual revenue and home renovation is becoming a very popular product in the home market. According to a report by Global Market Insights, Inc., India's home furniture market revenue in 2019 will grow from \$800 million in 2018 to around \$1.12 billion by 2025. Energy efficiency trends driven by favorable government policies and the need to cut energy costs are driving the growth of the home improvement market. India is currently offering tax incentives as part of green building regulations, which has also boosted the growth rate of the home improvement market. Other key aspects driving demand growth include rapid urbanization, internal and external migration, employment growth and the country's economic growth [01].

Process Involved in Renovation Work

The renovation process can generally be divided into several processes,

- Planning and designing
- Engineering
- Structural Repair
- Restoration
- Finish.

The processes and services required for a renovation are very specific, and once a plan is approved, building a new home is relatively predictable. Renovation works usually require all the partial operations necessary for the construction of a new building. During renovations, repair companies are often required to be flexible when unexpected problems arise. Renovation projects require not only flexibility, but also a plan agreed to by multiple parties. The planning process includes feedback from the project's financial investors and designers. Part of the plan also includes collecting data to complete the project, then reviewing and approving the project plan before proceeding with the renovation [29].

Works Involved in Renovation

- Ventilation, Doors, windows, and glass: installation of UPVC, Aluminum door windows and providing ventilation.
- Solar panel: setting up of solar panel systems.

- Solar hot water heater: setting up of roof top solar heater.
- Wall: adding walls for extending rooms and plaster work.
- Home extension: civil work like casting of column, beam, foundation etc.
- Paint: paint work of exterior and interior wall, ceiling.
- Electrical work: changing of old wires, switch boards and changing of old light fan or other electrical appliances.
- Bathroom: bathroom remodeling, adding bathtub, separate shower area, providing closet and dressing area.
- Kitchen: replacement of old kitchen into modular kitchen.
- Ceiling: installing ceiling in required area.
- Flooring: installation of tiles or marbles.
- Woodwork: replacement of furniture into new furniture and adding other furniture's.



Figure 1.1 Renovation Work of Living Area



Figure 1.2 Renovation Work of Kitchen



Figure 1.3 Renovation Work of Bathroom



Figure 1.4 Renovation Works of Study Room

Common Risks of Renovation Work

- When searching for something to renovate, the goal is to find something that is not in a condition that requires very serious work or renovation. While renovations may include removing items that are still in their useful life, they can only slightly increase the value of the property at a significant cost.
- Renovators can sometimes focus on more cosmetic aspects of a project while ignoring more important structural issues that can prove costly. Taking a "repair, not replace" approach as long as retaining a term attribute is cheaper than replacing it and as a result of it can add character to the attribute.
- Budgets are often overly optimistic because developers want to keep working. This can be risky because refurbishments are less predictable than new construction and many "hidden costs" are taken out of the original budget. In general, costs increase, and actual profits fall short of expectations.

Although the risk is a very common occurrence in the industry, it is significant in construction. Because it has many activities through multiple stages and can be done simultaneously unpredictable. Risk management practices are effective in anticipating and managing these risks. Weapons to limit the negative impact and negative consequences [13]. Risk management is an important part of the decision-making process in the manufacturing sector. And it is now widely recognized as an essential tool in project management. There is a consensus on this construction works risks are more extreme than in other industries. There are risks associated with the actions of all management and the decisions of all members. A risk is an event that is vague and can be positive or negative. Positive risks are an opportunity, but adverse risks are a threat and therefore inappropriate [10].

There are many environments, social, political, and other problems of considerable importance from the internal house, which can be spent a lot. As a result, to manage risks and reduce waiting costs and time, projects use the project management method in which project risk management is an integral part of project management in various projects. Systematic management is required. The risks and ambiguities that exist in construction weigh on other industries [15]. Risk management is the coordinated and economical application of resources, following the identification, assessment, and prioritization of risks, to reduce, monitor, and control the probability or impact of an unfortunate event, or to maximize the realization of an opportunity [8].

Risk Management

Risk management has appeared in the scientific and management literature since the 1920s. It became an official science in the 1950s when articles and books titled "Risk Management" appeared in library searches. Primarily research was related to finance and insurance. In the ISO 73:2009 manual, "Risk Management Vocabulary", terminology used often in risk management are defined [31]. Risk management standards are developed by various organizations such as the Project Management Institute [18], the National Institute of Standards and Technology, actuaries, and ISO standards. [07]. The project management literature has included Opportunities such as PMBOK [19] since the 1990s and has become an integral part of project risk management in the 21st century [31].

The PMBOK knowledge Project Management Authority defines risk management knowledge as the processes listed below:

1. Risk management planning - establishes the procedures for carrying out risk management operations.
2. Risk identification - identification of individual project hazard and their sources.
3. Conduct qualitative risk analysis - Prioritize individual project risks by assessing likelihood and impact.
4. Analyze quantitative risk assessment - Risk effect analysis using numbers.
5. Risk responses strategy - develop options, select strategies, and evaluate.
6. Track and implement risk mitigation measures - Monitor the execution of a risk response strategy that has been agreed upon [19].

The International Organization for Standardization (ISO) identifies following risk management principles [08]: Managing should,

- a) Value creation: the resources spent to reduce risk must be less than the result of inaction.
- b) Become an integral part of your organizational process.
- c) Participate in the decision-making process.
- d) Clarify uncertainties and assumptions.
- e) Run the systematic process and procedure.
- f) Build on the best information available.
- g) Consider the importance of people.
- h) To be able to constantly improve and enhance.
- i) Be able, adaptable, and responsive to change.

According to the "ISO-31000" standard, the risk management process consists of the following several steps:

1. Context settings
2. Determine the risk
3. Assessment of risks
4. Mitigation and treatment of risk
5. Risk Response plan
6. Execution of the plan
7. Plan review and evaluation

Significance and Purpose of the Work

During the pandemic (Covid-19), most ways of working shifted to work-from-home models and education systems switched to online mode as well. Tackling this situation, required a workspace to work from home and a study room to attend classes without any hassle. That's why nowadays the Renovation of apartments, buildings, and houses in its peak. Many people renovate their homes to give it a new look, want to renovate their homes to make them more energy efficient environmentally friendly and

sustainable, individual preferences, and needs may change over time. Renovating residential buildings is a difficult job to design, implement and construct there are many risks present in the project stages from start to completion.

This study focuses on risk management concepts and will involve relatives' thematic literature, elaboration of the questionnaire, and suggestions concerning risks management procedures in residential renovation. Residential renovation largely made by low and medium level construction companies and firms, sometimes families carry out renovation work from contractors by themselves. The study's goal was to shed light on the risk management process from a variety of participants' points of view, like site supervisor, site engineer, project engineer and project manager. To be content with this, an appropriate questionnaire prepared. A view of engineers, supervisors and consultants was carried out. So many participants were given the opportunity to answer questions and provide feedback (as indicated in the results) [8].

Objectives of Work

The study is carried with the following objectives:

- To study risks and risk management methods adapted to the residential renovation project through various roles from top management to the execution team [13].
- Identifying risks and estimating the likelihood, impact, and urgency of each risk [14].
- Develop a risk matrix to identify and rank high, medium, and low risks [10].
- Making risk register to store list of risks and their effects, their response plan for better monitoring of project risks [07].

Aim of the Dissertation

The aim of this study is to identify and evaluate current risks and uncertainties in the residential renovation industry through numerous literature reviews and aims to provide a basis for future studies to create a risk management framework adopted by potential supervisors and engineers.

Organization of the Dissertation

Chapter-1 Focuses on the introduction of topic and research motives.

Chapter-2 A literary perspective is presented with reference to this study.

Chapter-3 The research method is discussed.

Chapter-4 Identification and evaluation of risk management factors in residential renovation projects in India.

Chapter-5 The conclusions of this thesis work and recommendations for future work in this field are presented.

II. REVIEW OF LITERATURE

Below is a review of previous studies based on identifying construction risks.

Hung Duy Nguyen et al., 2022 presented results show that the topic of green building risks is quite early, but growing, and largely confined to several countries, including Singapore, the United States, Australia, and China. In particular, this study has discovered and classified the main topics of the risk research of Green Building. (1) Identification of risk factors in the implementation of a Green Building project, (2) Creating a risk assessment model for a Green Building project, (3) Determining a research risk according to a specific type of Green Building, and (4) Investigating the risk of an environmentally friendly improvement project is. In addition, a comprehensive list of green building hazards has been provided that can be a useful reference for industry practitioners and future researchers. In addition, the study identified gaps in the current literature, such as inconsistencies in the identification of green building risk factors, lack of research on the relationship between green building risks and project outcomes, and lack of exploration across countries or in developing countries. Finally, this study suggested future research directions enrich literature [09].

Mr. Nagarajan Muthu Krishnan et al., 2021 conducted the research to examine risks and risk management practices. Sixty (60) major risk capture and ranked. the risk is an event in a particular industry, construction project is important because it involves a wide range of activities at different levels and cannot be considered because it can do so simultaneously. To predict and manage these risks, risk management is an effective tool to prevent adverse effects and adverse events. This research dissertation focuses on the study of risk and risk management as it applies to operations development from a variety of roles ranging from senior management to staff level. Surveys were prepared and responses were collected from a sample of 132 experts/respondents across India. Operators should provide feedback based on their expertise, both current and past knowledge of the project [14].

Khalaf Ramadan Alzghib Alchammari et al., 2021 explained in their study that there is a significant statistical relationship between project risk management and project success. This research based on Bahrain's mega-construction sector; project risk management is positively correlated to its construction sector. Author says Project planning and risk management have a positive effect on project success, but knowledge management has not shown a significant impact on project success. It is argued that proper and timely planning and risk management are two factors that play a role in the success of major construction projects and therefore these factors must be managed well [11].

Chien-Liang Lin et al., 2021 proposed a new risk analysis model for construction projects that takes the whole project into account. The proposed model can be used as a reference for risk managers to make project risk decisions to achieve the end goal of resource saving and sustainable operation of the construction project. This study used the SEM methodology to investigate CPRM in Taiwan, structural equation modeling (SEM) was used to analyze the probabilities of negative events and the extent to which these events affect the project. Evaluation methods have been developed to determine the outcome of side effects and thereby provide a new perspective on CPRM., and specifically the risk factors that influence five dimensions (i.e., customer, design, contractor, subcontractor, and external factor) of risk problems. This study presents the following five risk management recommendations for parties involved in Taiwanese construction projects:

1. The contractor exercises careful supervision and management on site.
2. The subcontractors must improve the ability of field workers to read construction drawings.
3. Improve the education and training of these operators.

4. Designers professional knowledge should be respected, and updated information carefully followed.
5. Cross-departmental communication and coordination with customers should be strengthened for Reduction of unnecessary changes in decisions.
6. In terms of on-site operation, construction techniques should be improved, and legal restrictions and related legal changes should be carefully followed and responded to in a timely manner [06].

Maria Krechowicz et al., 2020 carried out research for identifying risks present in designing and construction of passive houses. Global climate change, rising energy prices and environmental concerns are fueling global interest in energy-efficient homes with low energy consumption and reduced environmental impacts. The process of designing and building a Passive House is more complex and involves many risks than building to traditional standards. A total of 30 risks have been identified in the design and construction of inert homes. The cause, effect, and possibility of diagnosis have been studied. Qualitative risk assessment for the design and construction of transient buildings is carried out using a type of damage and impact analysis. This helps in gathering information for decision-making and risk management. The results of qualitative risk assessment are also the beginning of the development of a comprehensive risk management strategy [15].

Study Corgi 2020 found that the RIBA Action Plan provides a framework for organizing and managing construction projects. Following the instructions outlined in the documentation, the consulting firm was able to provide appropriate design and financial advice to the client. To achieve this, it is important to identify risks, assess their magnitude, and take action to control and control them. The register will look at the general risks that have occurred in previous tasks. It will also focus on project-specific threats and those that will persist despite the controls in place. Strategic risk management enables clients to anticipate and prepare for uncertainty. As a result, the project is successfully completed [23].

Tian Yapeng et al., 2019 explained in their study Given the demand for quality healthcare, which must be met by existing building renovation projects. The author decided to test the effectiveness of the model, and “Beijing Football Club Hospital” was cited as a case study. To improve risk management skills, this article has used the ambiguous AHP method to build a risk rating system. Author said that according to result this model can effectively assess the risks of the hospital renovation project, and the risk level of the Beijing hospital project belongs to the intermediate level, which is mainly in the design and construction stage [26].

Sarah Phoya et al., 2018 explained in their research Construction workers were involved in the study informal areas in Dar es Salaam and Mwanza in Tanzania. The largest cities in Tanzania with more informal construction workers are Dar es Salaam and Mwanza. Questionnaires were prepared in English, translated into Kiswahili, and administered by research assistants through informal construction workers. The employees were deliberately selected. Of 1,000 questionnaires distributed, 849 questionnaires were filled out correctly, which is 84.9%. The process of selecting and responding to risks largely depends on human experience, perceptions, and judgment. [20].

Mohammad Abazid et al., 2018 the study was carried out in order to obtain a comprehensive conceptualization of risk and the consequences it has in the fields of construction and the required management operation. Along with the utilities and techniques adopted to control risk in the construction industry, the effect of risk on the project assessment is also discussed. The aspiration of the topic of research is to be able to enquire into the productive method of implementing risk management in the construction industry, to be able to respect the various types of managing techniques manipulated to reduce risk, to define the utility of implementation of the risk management, to resolve the components that affect the execution of risk management in the life cycle of projects. The following study discloses the research which focuses on distinguishing the practices of risk management and construction projects in the Arab region [17].

Jameel Ahamad Nadaf et al., 2018 outlined in their study that the qualitative risk analysis methods used to collect data, analyze data, and report results. The chosen method of risk management is to distribute questionnaires to the various contractors, clients, and consultants of the project. Use qualitative risk analysis to analyze data, probability impact, impact urgency of impact, likelihood, urgency, and priority contingency matrices to identify high risks and create high risk charts [10].

Mayank Kumar Singh et al., 2017 focused on the general concept of risk management for a project in their research. The questionnaire was created from the literature on construction risk management. Discussions were held with personnel working in the construction industry to identify and assess construction risk factors. Authors find out that the Formal risk analysis and management techniques are rarely used in the construction industry due to a lack of industry experience and knowledge. The industry also doubts that these techniques are similarly appropriate for use in construction projects way used in other industries. Risk perception by the contractor is mainly based on their intuition and experience. According to this finding, training of these professionals on risk management, and thus a formal and informal risk system, is essential. Management training should be developed. Informal education can be delivered through professional development and training programs, such as risk management Awareness Programs [16].

Timo Kauppinen et al., 2015 presented three case studies on risk management. The first case describes the management of risk and success factors in building services lifecycle projects and is an application to the design phase. The second case systematically how to manage the air quality risks in the ventilation system during use. The third case consists of an assessment of the risks associated with responsibility for energy consumption of technical building management systems. The three cases presented show the possibility of using the methods in the pre-design, design, and operation phases. The risk table approach is a checklist-like method and is an excellent tool for estimating all the risks present in a construction project. The stages of risk analysis include goal setting, risk identification, impact assessment, probability calculation, overall risk assessment, and finally risk elimination, reduction, and prevention. Parties involved in enforcement projects are typically judged on their ability to take responsibility for risks. Responsibility is placed on the parties to which it can be governed and to which it naturally belongs [25].

Nerija Banaitiene et al., 2012 presented research results show that the Lithuanian construction company is very different from foreign construction companies in the adoption of risk management procedures. Lack of experience makes it very difficult to change the attitude of Lithuanian contractors regarding disaster risk management. Risk assessment methods are widely used in

construction companies. Risk management in the case of project construction management is a comprehensive and systematic approach to identifying, analyzing and responding to risks to achieve project objectives. An effective risk management process encourages the construction company to identify and evaluate risks and consider risk mitigation policies and risk reduction policies. Successful and effective risk management construction companies enjoy financial savings, as well as greater productivity, improved success rate for new projects and better decision-making [18].

III. METHODOLOGY

Risk Identification

The first step in the risk management process is to identify the risk. Of course, projects vary, but for organizations that manage similar projects year after year, to help identify typical risk categories for that kind of project, historical data may be available. As new risks develop throughout the course of a project, risk identification is a process that is iterative. [07]. The format of the risk assessment should be continuous so that the impact of one risk on another can be compared. Members of the project team are involved in the identification process within the organization. For this purpose, many risks arising from the construction, mobilization and construction phases of the production process are categorized and catalogued. By bring your team together to discuss the risks. All stakeholders are responsible for various areas of the project, so they contribute their knowledge to help determining the risk of project derailment. We identify risks by literature review, by on call interview, by visiting sites based on experience of construction participant.



Figure 3.1 Site Picture of Greater Kailash, New Delhi



Figure 3.2 Site Picture of Janakpuri, New Delhi



Figure 3.3 Site Picture of Vasant Kunj, New Delhi



Figure 3.4 Site Picture of Dwarka, New Delhi



Figure 3.5 Site Picture of Noida sec- 62, UP

Design of Questionnaire

The data collection process used in this survey involved choosing two basic strategies: questionnaires and one-on-one interviews of 05 selected renovation project based on Delhi NCR. As a result of empirical observations, there are risks related to construction risk [15], the types of which are listed below:

1. Architectural and construction design risk
2. Human resource risk
3. Managerial / Organizational risk
4. Risks related to costs
5. Socio-political risk
6. Environmental risk.

The proposed questionnaire which is used in this research methodology for completing risk assessment practice is shown below,

1. Architectural and construction design risk

- **Complicated design, and shape. by the designer** (To construct, renovate, refurbishing, rebuild or demolish buildings or structures are complex task. There is lots of complexity in designing and shaping the existing structure. Many designers fail to give a proper design and shape on drawing with lack of details. Which lead to poor execution of project)
- **inadequate selection of materials used when planning the construction process. by the designer or client** (Material selection is critical to the success of the engineering design process. You want your product to be as strong and long lasting as possible. If designer does not have much knowledge of materials and convincing techniques to tackle client for selection of good materials. That lead to design failure and affect the requirement.)
- **Incorrectly designed layout. by the designer** (Efficient and accurate placement of sites can ensure work is done efficiently and safely. Poor design effects can lead to cost overruns, loss of company reputation, manufacturing problems, and time constraints.)
- **Changes in design. by designer or client** (Changes in a construction renovation project are familiar and expected. The top three common impacts of design changes are time overruns, cost overruns, and requirements.)
- **Inadequate investigation on site. by the supervisor** (An inspection is one of the first steps in any construction project. Reliable information obtained from a site survey report enables designers to design solid and durable construction projects.)
- **Controlling and monitoring and execution. by the project in charge** (The site manager organizes and manages budgets, sets and adheres to schedules, oversees site safety, and ensures that everyone completes work on time. Keeps a close eye on the entire project management lifecycle and ensure project activities are moving in the right direction.)
- **Failure to carry work as per planning, scheduling** (A clear overview of the work plan and an established communication process allow team members and stakeholders to coordinate in line with a common vision.)
- **The lack of coordination between project participants** (Lack of coordination between management, labour, production, and sales leads to delays and makes the organization inefficient. Therefore, a specific roadmap needs to be set for a manager or team leader serving a team. Effective project coordination can increase your team's productivity in the workplace.)

2. Human resource risk

- **Labour dispute. by contractor** (Workplace conflicts lead to dysfunction, which negatively impacts the outcome of the project and stakeholders. The biggest cause of construction labour disputes is the demand for higher wages and allowances.)
- **Low productivity and unavailability of labour** (The most common reason for low productivity at work can be attributed to the lack of proper employee training. When workers are not trained properly, it will automatically create hurdles in time and resource management. In the construction sector, manpower is the most necessary and important capital to carry out a construction project. Most of Cases local labour not available nearby of the site location.)
- **Shortage of experts** (Due to shortage of skilled workers at construction sites, it takes longer time to complete the structures)
- **Unskilled labour force** (Unskilled labor is one of the main causes of construction defects in the construction sector)
- **Improper scheduling and delay of contractor** (Contractor failure like delay in progress or completion, lack of knowledge, poor project management, and poor cost estimation. Sometime contractors breach the contract which cause delay in project delivery.)
- **Insufficient contractor experience** (The lack of experience of the contractor is a major cause of delays. The contractor must have sufficient working capital and high efficiency equipment to work, able to solve problems on the spot. Before hiring contractor, background of the contractor should be checked.)

3. Managerial / Organizational risk

- **Lack of resources during the project execution** (Without sufficient or inadequate resources, the project may not meet your expectations, complete on time, and risk staying within your financial budget. Monitoring project resources throughout the project is essential to avoid resource shortages.)
- **Indistinct contractual relationship** (The possibility of facing losses due to the poor performance of the deal. Good client relationships can lead to repeat business, referrals, and word of mouth marketing)

- **Inappropriate planning, estimate incomplete or inaccurate** (Incorrect cost estimates can put your project on hold. Profits are generally gained or lost based on the accuracy of estimates and how they match the final costs of the project.)
 - **Incomplete approval** (Detachment is one of the most common group work issues that everyone faces at work. Teams tend to diverge when they don't have the right direction or vision. It is the project manager's responsibility to ensure that all objectives are assigned to the correct person or team. Even so, a project manager must ensure that all parties are held accountable for their duties.)
 - **Lack of inter-branch coordination** (The conflicts within organizations that often arise from inappropriate communication between men, materials and ideas are some of the major problems of contemporary organizations. Personal supervision and establishing informal contact with employees help to create an atmosphere of mutual trust and cooperation and is the basis of healthy coordination)
- 4. Risks related to costs**
- **Variations by the client** (A variation is a change in the scope of work provided for in a construction contract.)
 - **Delays in worker wages** (Construction workers face many problems such as lack of job security, low wages, increased working hours, and lack of social and medical services. Wages are a very important issue for workers. Which lead low productivity.)
 - **Increase in cost of materials** (Increases or decreases in prices/costs of various components of the work during the period of the construction work)
 - **Releasing of funds** (Timely releasing of fund from client leads to complete project on time.)
 - **Delayed payments** (Financial mismanagement by employers, disputes between contracting parties and delays in certification are some of the potential causes of late payments.)
 - **Price fluctuation** (Price fluctuations are real, but they don't have to be a burden to trained and protected general contractors. A typical practical approach to mitigating risks is to identify costs as quickly as possible by immediately connecting subcontractors once the price is agreed with the owner.)
 - **The inflation of construction materials incomplete approval** (After price inflation, approval for purchasing material need to be done by the site supervisor and engineer. Time taking of approval may lead work delay.)
- 5. Socio-Political / Environmental risk**
- **Public complaints** (Home improvement benefits everyone, including our neighbors. Do not hesitate to remind them. By working under the guidelines of society and working in normal working hours.)
 - **Permissions, clearance, approvals** (Taking permission and approval from the client and society prior to the starting of project. permission like, to use lifts or space for storing material etc.)
 - **Weather and seasonal variations** (Climate change increases the risks associated with starting the construction project cycle. Climate change can directly affect the construction industry through weather and climate, but it can also have indirect effects such as on-site scheduling, delays, additional costs, worker safety, material costs and shipping.)
 - **Changes to pollution and safety rules** (Construction contributes relatively strongly to air pollution. Hazardous chemicals used during construction can be harmful to workers and the environment. Implementing workplace measures to minimize pollution can have a positive impact on workers and communities.)
 - **Changes to laws governing export/import restrictions** (Changes of import export rules may lead to increase material cost, shortage of material. Which cause delay in construction project.)

Survey and Data Collection

Writing accurate data is one of the most important steps to achieving your research goals. Data collection is a way of collecting information about data related to an assessment or analysis. Approximately 05 questionnaires were sent to project managers and engineers and interviews with site workers, including manager, contractors, supervisor, engineers. We create a questionnaire by google form and sent it to the 05 selected companies for survey. After completion of survey, we convert google form into spreadsheet and analyze the data for further research.

Qualitative Risk Analysis

A good risk assessment includes identifying the potential and impact of various risks, identifying risks, monitoring their significance will help you do better work. The outcome or likelihood of the risk occurring determines the risk assessment., the consequences of the risk, should it materialize, as well as the requirement to take action. Below is a table listing responses to the questionnaire and an analysis of the data,

Category of risks re shown in grey background. Probability is shown in blue background. Series 1 indicate response of first company same as series - 2,3,4,5 indicates for all 05 company responses.

Table 3.1 Analyzed Questionnaire Responses

Questions	Serie s 1	Serie s 2	Serie s 3	Serie s 4	Serie s 5
Architectural and construction design risk					
Complicated design, and shape. by the designer [Probability]	3	10	2	10	4

Complicated design, and shape. by the designer [Impact]	4	9	3	6	5
Inadequate selection of materials used when planning the construction process. by the designer or client [Probability]	3	10	1	10	5
Inadequate selection of materials used when planning the construction process. by the designer or client [Impact]	3	9	2	5	4
Incorrectly designed layout. by the designer [Probability]	2	10	1	5	6
Incorrectly designed layout. by the designer [Impact]	3	10	2	10	6
Changes in design. by designer or client [Probability]	4	10	2	3	8
Changes in design. by designer or client [Impact]	7	10	3	6	5
Inadequate investigation on site. by the supervisor [Probability]	4	9	1	4	5
Inadequate investigation on site. by the supervisor [Impact]	6	10	2	8	9
Controlling and monitoring and execution. by the project Incharge [Probability]	4	10	3	10	3
Controlling and monitoring and execution. by the project Incharge [Impact]	4	10	3	10	2
Failure to carry work as per planning, scheduling [Probability]	4	9	5	10	6
Failure to carry work as per planning, scheduling [Impact]	7	10	6	10	5
The lack of coordination between project participants [Probability]	3	10	2	10	6
The lack of coordination between project participants [Impact]	8	9	4	10	7
Human resource risk					
Labour dispute. by contractor [Probability]	3	10	3	10	7
Labour dispute. by contractor [Impact]	6	10	3	10	6
Low productivity and unavailability of labour [Probability]	3	10	3	10	7
Low productivity and unavailability of labour [Impact]	7	10	3	10	7
Shortage of experts [Probability]	3	10	1	10	8
Shortage of experts [Impact]	6	9	1	10	9
Unskilled labour force [Probability]	2	10	3	10	6
Unskilled labour force [Impact]	5	10	4	10	8
Improper scheduling and delay of contractor [Probability]	3	10	3	10	7
Improper scheduling and delay of contractor [Impact]	7	10	3	10	8
Insufficient contractor experience [Probability]	2	1	3	10	4
Insufficient contractor experience [Impact]	7	1	3	10	4
Managerial / Organizational risk					
Lack of resources during the project execution [Probability]	4	10	2	10	7
Lack of resources during the project execution [Impact]	8	10	2	10	6
Unsatisfactory skilled staff [Probability]	3	10	3	10	7
Unsatisfactory skilled staff [Impact]	5	10	3	10	8
Indistinct contractual relationship [Probability]	2	10	1	10	4
Indistinct contractual relationship [Impact]	5	10	1	10	2
Inappropriate planning, estimate incomplete or inaccurate [Probability]	3	10	1	10	7
Inappropriate planning, estimate incomplete or inaccurate [Impact]	7	10	3	10	9
Incomplete approval [Probability]	3	10	7	10	8
Incomplete approval [Impact]	7	10	9	10	7
Lack of inter-branch coordination [Probability]	3	10	2	10	6
Lack of inter-branch coordination [Impact]	5	10	3	10	5
Risks related to costs					
Variations by the client. [Probability]	4	10	6	10	7

Variations by the client. [Impact]	8	10	6	10	8
Delays in worker wages [Probability]	4	10	4	10	9
Delays in worker wages [Impact]	9	10	4	10	10
Increase in cost of materials [Probability]	4	10	2	10	9
Increase in cost of materials [Impact]	6	10	3	10	9
Releasing of funds [Probability]	3	10	1	10	3
Releasing of funds [Impact]	7	10	1	10	2
Delayed payments [Probability]	3	10	9	4	8
Delayed payments [Impact]	7	10	10	4	9
Price fluctuation [Probability]	2	10	3	10	7
Price fluctuation [Impact]	4	10	5	10	6
The inflation of construction materials incomplete approval [Probability]	3	10	5	10	5
The inflation of construction materials incomplete approval [Impact]	5	10	5	10	6
Socio-Political / Environmental risk					
Public complaints [Probability]	3	10	8	10	8
Public complaints [Impact]	5	10	8	10	9
Permissions, clearance, approvals [Probability]	3	10	3	10	7
Permissions, clearance, approvals [Impact]	5	10	4	10	6
Weather and seasonal variations [Probability]	4	10	5	10	8
Weather and seasonal variations [Impact]	7	10	5	10	10
Changes to pollution and safety rules [Probability]	4	10	6	10	7
Changes to pollution and safety rules [Impact]	8	10	6	10	5
Changes to laws governing export/import restrictions [Probability]	2	10	8	10	7
Changes to laws governing export/import restrictions [Impact]	5	10	9	10	6

Probability / Impact Risk Assessment Matrix

Probability and impact, which is used in the previous step, is used as a basis of qualitative analysis. For this reason, the conclusion of critical analysis uses a variety of computational methods in the data. Westland calculates priority evaluation as a probability and impact device. Priority games, evaluation and colors are allocated to show the importance of each risk. High impact threats and potential hazards are known as high risk and may need instant response, while the monitoring of low priority can be done with low priority data, if they are only necessary [08].

Legend:

Red - risks that require an answer.

Yellow - risks that require further analysis and research.

Green - not enough risk.

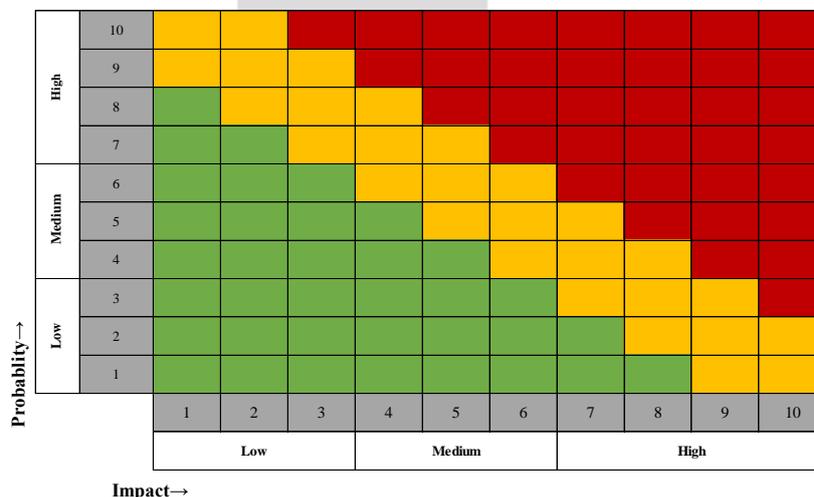


Figure 3.6 Probability Impact Matrix**Risk Mitigation**

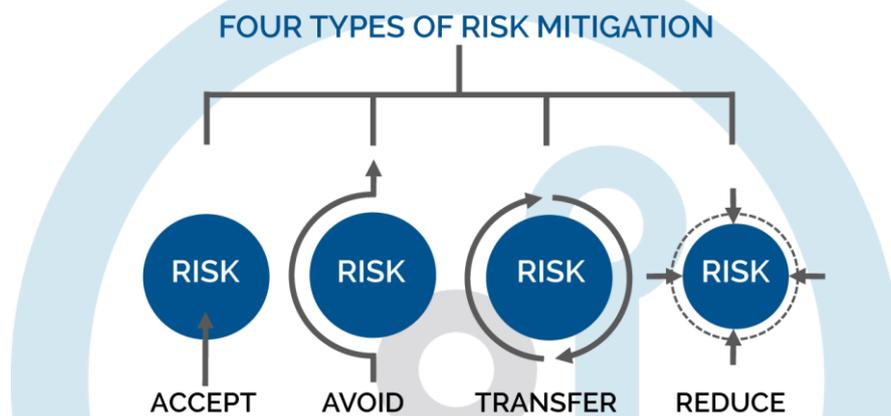
The act of taking measures to limit side effects is known as risk minimization. When it comes to business continuity and catastrophe recovery, there are four different sorts of risk reduction solutions. It is crucial to create a risk-mitigation strategy that is compatible with the business profile, based on an evaluation of the cost/benefit of mitigation [06].

ACCEPT Risk: For some risks, The cost of mitigating the risk is more than the cost of the risk itself. In these situations, you must be cautious and accept the risk.

AVOID Risk: Generally speaking, risks that have a high likelihood of having an impact on monetary losses and damages must be avoided.

TRANSFER Risk: Sharing or transferring should be used to lessen risks that are less probable but have a significant cost impact.

REDUCE Risk: The most popular kind of mitigation is risk reduction, as in Companies are adopting specific actions to address perceived risk and manage their exposure. Risk mitigation usually involves some risk acceptance and some risk aversion.

**Figure 3.7 Types of Risk Mitigation****Risk Register**

A risk register is a tool in risk management and project management. It is used to identify potential risks in a project or organization, sometimes to meet regulatory compliance but more importantly to track potential issues that could affect expected results. Although risk registers are primarily used during project implementation, they are a part of management strategy, and the project manager should give them careful thought when the project is being planned. There is never a bad time to consider project risk assessments. As a result, you need a risk record for your project in order to manage risk. Each risk detected in the project is fully described in the risk log, including the risk's nature, the degree of impact risk, who owns it, and what mitigation measures are in place to respond to it. Although it is not possible to anticipate every dangerous situation that can arise in a project, dedication can help you improve risk management practices that allow you to react quickly before the risk becomes the real problem.

Any project under consideration would benefit from maintaining a risk record to track project hazards, whether through a straightforward spreadsheet or as part of a more capable project management software solution. When managing a project, risk management employs a systematic approach to deal with prospective issues that could manifest more frequently than others. Therefore, you need a risk analysis system to gather prospective risks, then map out a course to take to mitigate those risks and return the project to schedule if they materialize [07].

Each organization and project may have a different risk register. The majority of risk register templates, however, include these widely used components:

Index: An identification of the risk by name or number.

RBS: A risk breakdown structure is a method that enables you to categories each project risk.

Category: Many categories of risk can impact a project, including design risk, human resource risk, cost risk, socio-political and environmental risk.

Description: A brief description of the risks.

Effects: Defines the risk effect on project.

Probability: It is necessary to determine each risk's likelihood and allocate.

Impact: It is necessary to determine each risk's effect and allocate.

Risk rank: Applying probability and impact multiplication to rank all risks.

Owner: The team member designated as the risk owner must be given responsibility for each risk. The risk owner is in charge of supplying and overseeing the proper reaction.

Response plan: Each risk requires a risk response to minimize the impact on the project. These risk responses are also documented in the risk response plan.

Index	RBS	Category	Description	Effects	Probability	Impact	Risk Rank	Owner	Response Plan

Figure 3.8 Risk Register

Risk Response Plan

Obviously, there are risks, so it is important to have a risk response plan. Project management involves organizing activities to meet deadlines and budget constraints. Project risks may have an impact on this plan and raise expenses. The sooner you spot them and address any issues, the more likely it is that your project will be successful. As a result, risk response planning is a method for reducing or getting rid of risks to your project. Additionally, it can be used to improve the opportunities that positive risk presents. This means that you will have a well-thought-out plan on how to fast reap the benefits of your project to the fullest if there are positive risks that can help it. A strategy gives the project manager a number of risk-reaction options to lessen negative risks. According to its definition, risk is uncertainty that could have either a good or negative impact on a project [08].

Strategies for managing negative risks (threats)

Here are four risk strategies listed below,

Avoid: Using any measures necessary, this risk response technique aims to neutralize the threat. This can entail altering the project management plan to eliminate risks since they are harmful to the project.

Mitigate: Some project risks cannot be avoided. The ones you require to reduce the project's unfavorable risk effect.

Transfer: As the term implies, you delegate or transfer the responsibility for project risk management to a third party here by, for example, buying insurance or signing a warranty and guarantee.

Accept: As part of this risk response plan, the risk is identified, along with all relevant risk management data, but no action is taken until the danger actually materializes.

Risk Management Techniques for Positive Risks (Opportunities)

Exploit: If there is a favorable risk or opportunity that you want to take advantage of, you must increase your workload or alter your management strategy. This strategy is risky, but it frequently pays off.

Enhance: Here, you increase the chances of a positive threat happening in your project.

Share: Share your risk response with other partners in other teams or projects here. This may entail including seasoned team members on various initiatives.

Accept: This risk response method calls for detecting the risk, documenting the relevant risk management data, but delaying taking any action until the danger manifests itself.

The plan includes risk identification, activities related to risk response, and risk owners for interventions. Planning is a way to structure your strategy so that no steps are skipped. Priority must be given to responding to risks, considering the possibility and level of impact of the risks. Then determine if it is profitable and realistic, and if you do, you will be successful. The risk assessment must be approved by all parties, especially project stakeholders. The plan will use one of the above risk response strategies. Then there are risky triggers that stop the plan. These responses should also have priority, from low chance and low impact to high chance and high impact. This will help you determine what risks you should respond to.



Figure 3.9 Risk Response Plan

Monitoring risks

Throughout the project, the project team continuously monitors existing risks. In addition, we regularly carry out activities to identify new risks.

1. The project team regularly reviews the risk log.
2. The project teams regularly organize brainstorming sessions.
3. Risk impact and probability are under the control of the risk owner.
4. The risk owner assesses how well the risk response has worked.
5. The risk holder keeps track of the risk in a record.
6. The project manager will keep guiding the group and clients in effective risk management techniques.
7. Technical experts can perform risk assessments upon request.

IV. RESULT AND DISCUSSION

SUMMARY

A survey of 05 construction companies and their average issues are summarized below.

Table 4.1 Responders Details

Table 4.1 shows all 05 selected renovation project based on Delhi NCR. As a result of empirical observations, companies'

Series	Age	Work Experience	Company Name	Worked In	Location of the project	Position
1	38	15 years	ANSA Interior and Architectural Design	Consultant	Janakpuri, New Delhi.	Project Manager
2	35	11 years	HC Interior	Consultant	Dwarka, New Delhi.	Project Engineer
3	30	5 years	Aarcon	Real State	Greater Kailash, New Delhi.	Site Engineer
4	28	4 years	Home Clues	Consultant	Noida sector 62, UP.	Site Engineer
5	27	4 years	HC Interior	Consultant	Vasant Kunj, New Delhi.	Site Supervisor

participants details, about their experience, mode of work, position in firm, the type of project in which they deal. Series 1 indicate response of first company same as series 2, series 3, series 4, series 5 indicates for all 05 company responses. Based on their experience of participants we categorize them in three categories below 05 years, 05 to 10 years, and 11 to 15 years. We connect with 2 participants of below 05 years experience, 01 participant having 05 year of experience, and 02 participants of 11 to 15 years of experience. We contact them via phone call and ask them about their project and their company details. Their work culture, how they manage their site, how they manage risks.

Details of all selected 05 companies are described below,

1. HC Interior (series 02 and series 05) Delhi-NCR's residential and commercial interior design firm office in Noida. Offers its premium interior designing solution to all the people who are looking forward to creating amazing places. clints will get the overall aesthetic experience and that would simply change the way their look at their home. HC Interior deliver,
 - All kinds of Turnkey Projects
 - All types Flooring
 - Modular Kitchen
 - Furniture Design & Build – Commercial Building
 - Wall Treatment
 - Floor design & build
 - creation of workstation
 - Interior Tiles, Pavers, Granite, and Marble Fixing.
 HC Interior handles the designing process for its customers. It offers a wide range of designing solutions from start to finish.
2. ANSA Interior and Architectural Design Consultancy (series 01) based in Delhi NCR, corporate office in Mayapuri, New Delhi. They specialize in creating sophisticated interiors that reflect the best in modern architecture and design. They assist their clients at every stage, including creating layouts, monitoring the site, and assisting our clients with ordering, purchasing, and managing budgets. They assist their clients in developing the house or office of their dreams.
3. Aarcon (series 03) based in South Delhi and corporate office located in Greater Kailash, New Delhi. A real estate developer specializing in boutique housing projects. They offer their clients a broader selection to choose from when moving in. Aarcon's buildings combine style and comfort are lavish in experiences. The stylish interiors and artistic exteriors have made their luxury boutique residential projects a preferred choice among the elites. They offer luxury housings to their clint in posh area of South Delhi.
4. Home Clues (series 04) based in Delhi NCR and corporate office in Ghaziabad, Uttar Pradesh. They deal in property and interior. Home Clues is one of the leading real estate consultancies providing end-to-end solutions for all residential as well as commercial properties, offering an exclusive and customized home design solutions, professional interior design and renovation services for homes.

After distribution of questionnaire survey with the help of google form. The 05 companies participants responded and filled google form accordingly. After receiving those response, summarizations of provided data is done in Microsoft excel. The figure given below shows the data of risks probability and impact that present on site by graphical representation. After successfully completing summarization of data, we done qualitative risk analysis. By preparing probability impact assessment matrix shows in (fig. 4.6).

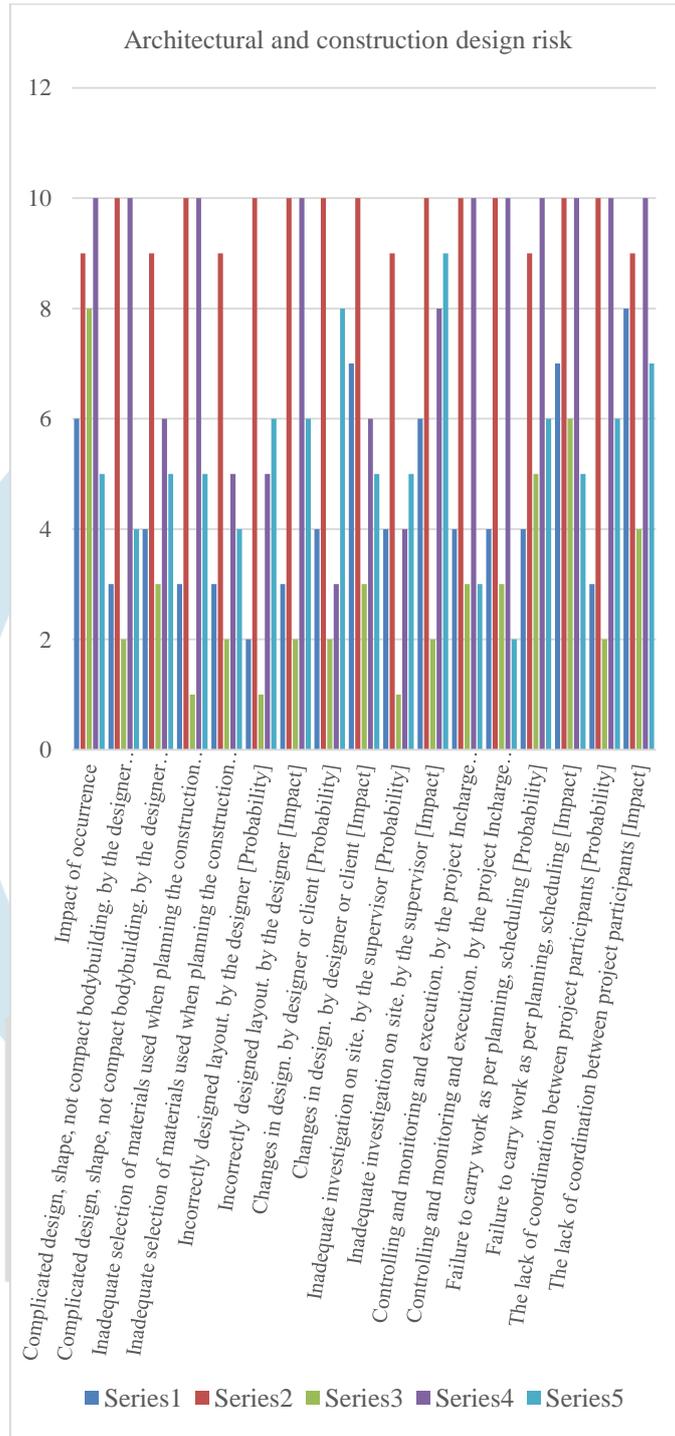


Figure 4.1 Architectural and construction design risk

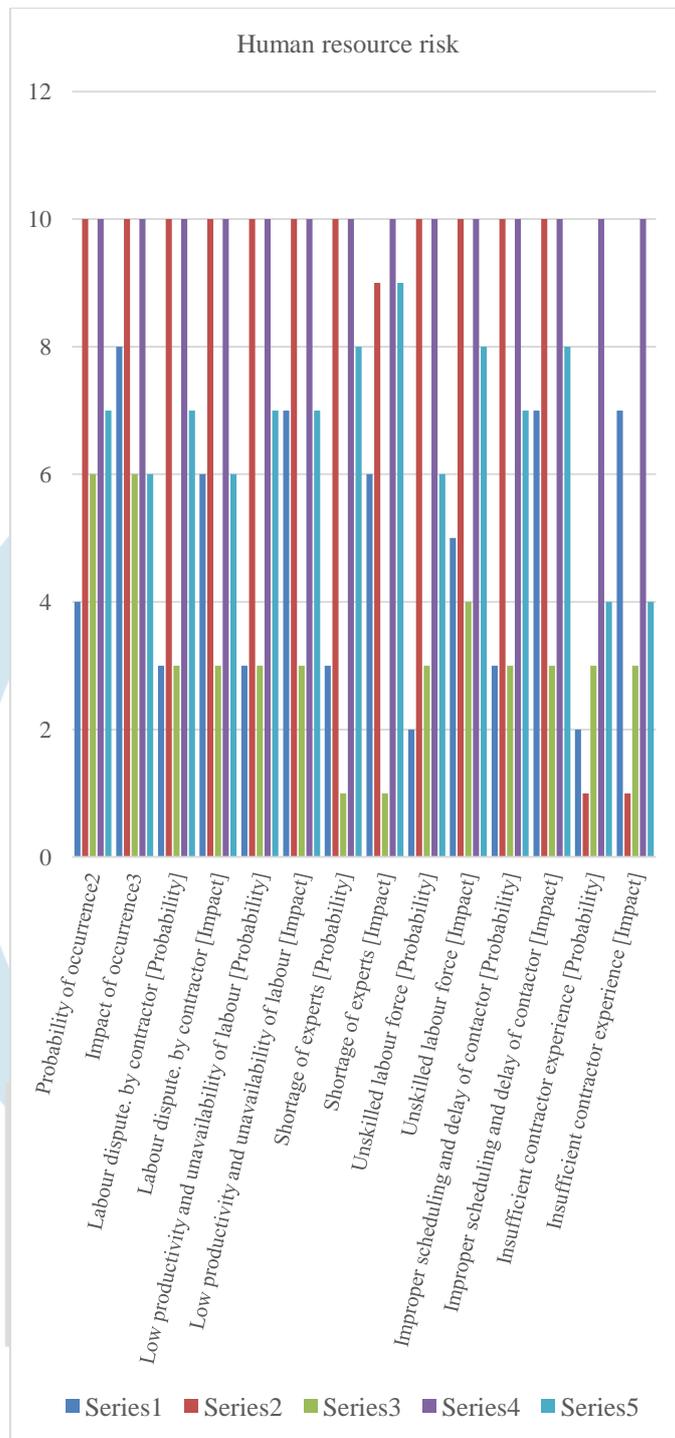


Figure 4.2 Human resource risk

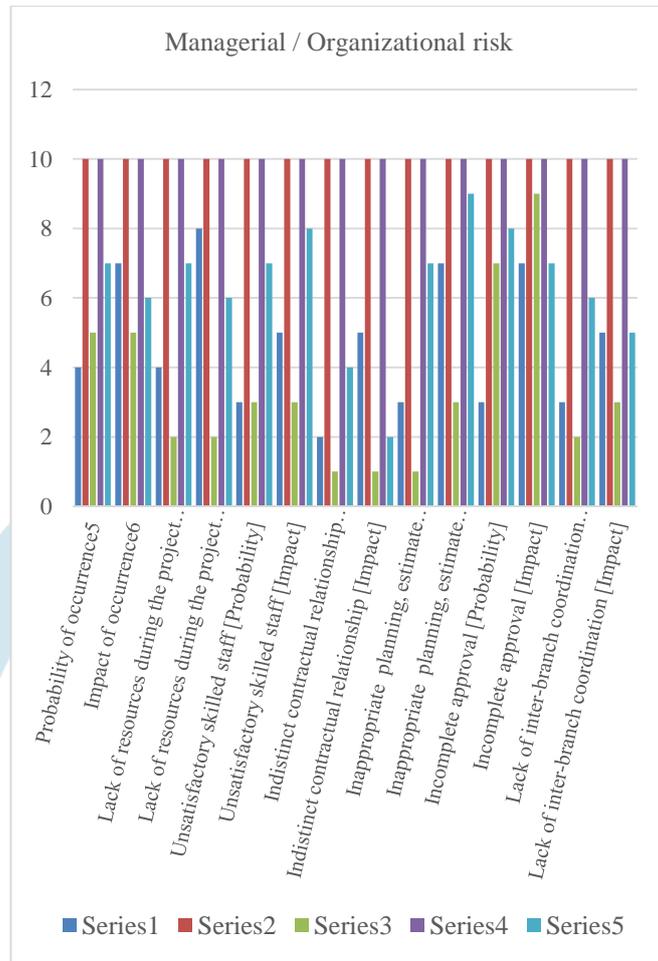


Figure 4.3 Managerial / Organizational risk

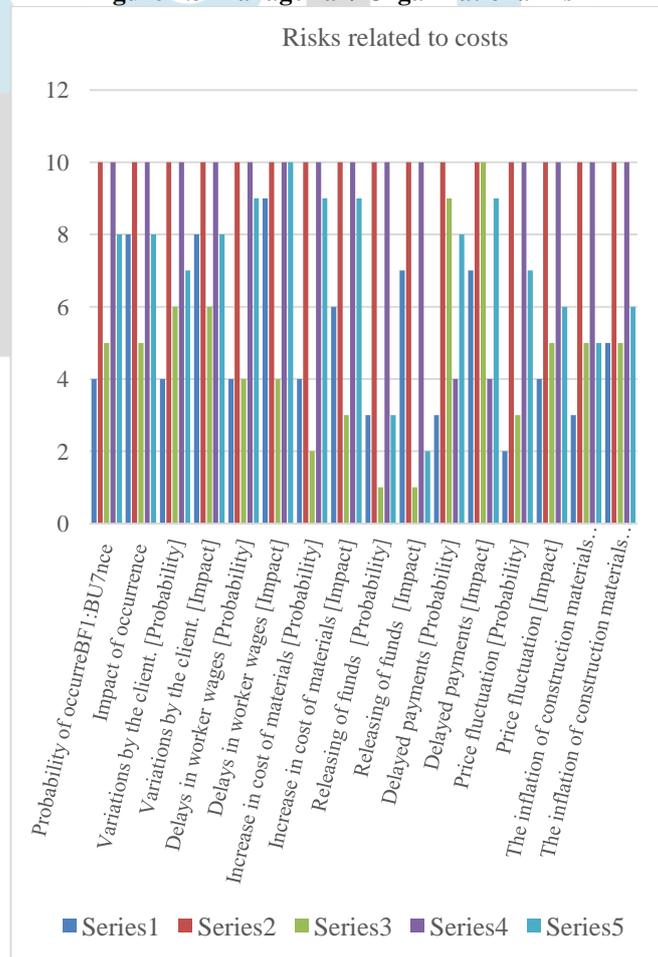


Figure 4.4 Risks related to costs

Architectural and construction design risk			
ID	Task	P	I
A1	Complex design, and shape. by designer	4	5
A2	Insufficient choice of materials when planning a construction project. by design or client	5	4
A3	Poorly designed layout. from the designer	6	6
A4	Design changes by designer or client	8	5
A5	Inadequate on-site investigation. by the supervisor	5	9

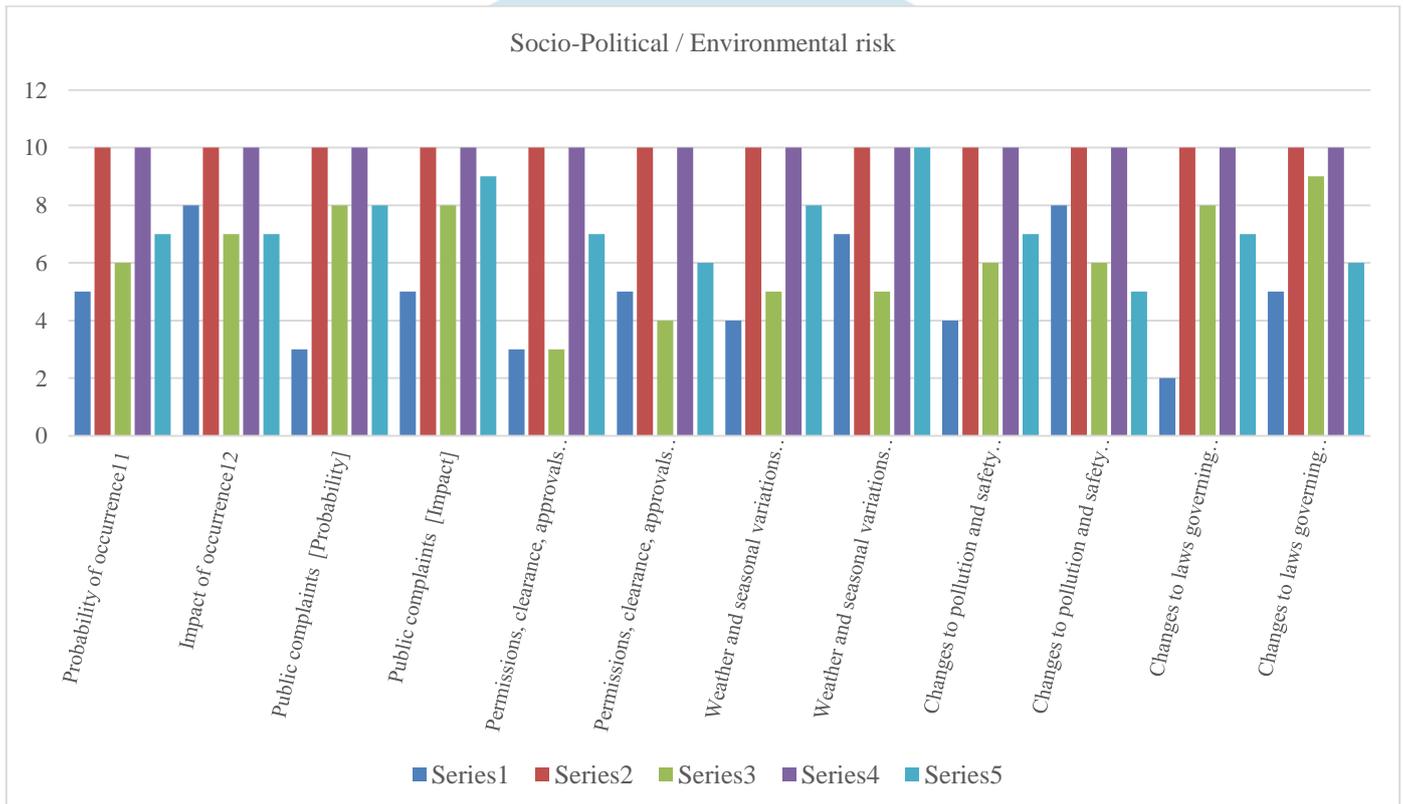


Figure 4.5 Socio-Political / Environmental risk

Table 4.7 shows the controllable sources of risk identified in the study categories into: Architectural and construction design risk, Human resource risk, Managerial/Organizational risk, Risks related to costs, and Socio-political/Environmental risk which is under the control of the project team.

Probability / Impact Risk Assessment Matrix

Risk assessment is done by rating the risk and taking the average potential and impact obtained from the assessment. The matrix below has three values that can be identified by the color spectrum: high, medium, and low. Red hedges represent a high risk, yellow blocks represent a medium risk, and green blocks represent a low risk. The matrix below shows probabilities and effects of risks.

A6	Control and monitoring and enforcement. by project management	3	2
A7	Inability to work according to plan	6	5
A8	There was no coordination among project participants	6	7
Human resource risk			
ID	Task	P	I
H1	Labour conflict by the contractor	7	6
H2	Low productivity and unavailability of manpower	7	7
H3	Lack of experts	8	9
H4	Unskilled workers	6	8
H5	Contactor failure and delayed programming	7	8
H6	not enough experience as a contractor	4	4
Managerial/Organizational risk			
ID	Task	P	I
M1	Insufficient resources during the project	7	6
M2	Unparalleled contractual relationship	4	2
M3	Inappropriate planning, estimate incomplete or inaccurate	7	9
M4	Insufficient consent	8	7
M5	There is no coordination between domains	6	5
Risks related to costs			
ID	Task	P	I
R1	Variation by the consumer	7	8
R2	Wage delays for workers	9	10
R3	Increase in the price of supplies	9	9
R4	Release of funds	3	2
R5	Delayed payments	8	9
R6	Price fluctuation	7	6
R7	The inflation of construction materials incomplete approval	5	6
Socio-Political/Environmental risk			
ID	Task	P	I
S1	Dissatisfied neighbors	8	9
S2	Permits, authorizations, approvals	7	6
S3	Climate and weather changes	8	10
S4	Pollution and safety rules changes	7	5
S6	Amendments to the Import and Export Restriction	7	6

Table 4.2 Risk Categories

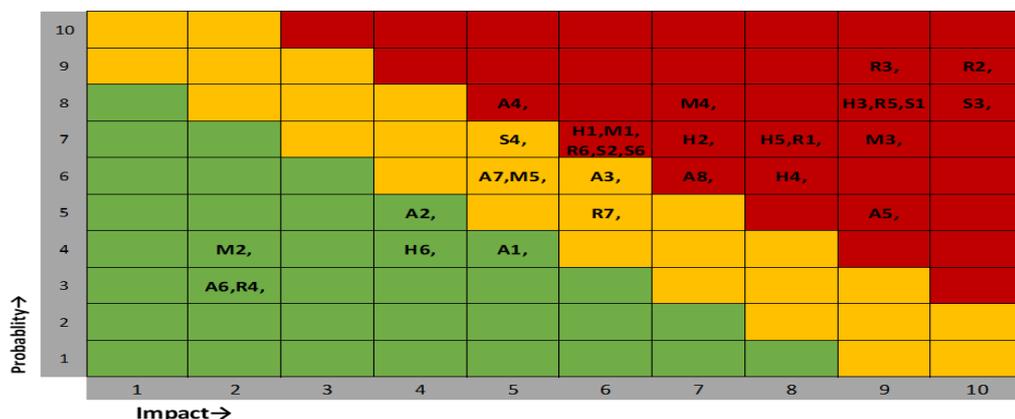


Figure IV.1 Probability Impact Risk Assessment Matrix

Legend:

Red - risks that require an answer.

Yellow - risks that require further analysis and research.

Green - not enough risk.

After identifying the probabilities of the risks and their impact, the rank of risk can be calculated. The rank of risk is detailed in Table 4.2 details. It shows the classification of risks allocates individual risk factors into specific risk categories. The risk matrix represents a combination of impact and probability, The probability and impact assessment matrix (Fig. 4.6) shows severity of risk low, medium, and high (shown in red, yellow, and green). A positive risk assessment can lead to further assessment and quantitative analysis or immediately to a risk response plan.

In significant internal risk categories, 36 risk variables were found. The biggest risk factors ascribed to the contractor in the design risk category were design errors/parts and design process delays. The most often reported risks in the project management risk category were planning mistakes and contract quality standards non-compliance. The most commonly reported risk factors for engineers in the field of construction risk were excessive building prices and technological advancements.

According to respondents these risk result cause poor quality work, delays, and related damages. risk such as R2 (Wage delays for workers), S3 (Climate and weather changes), M3 (Inappropriate planning, estimate incomplete or inaccurate), and H3 (Lack of experts), R3, R5, S1, H5, R1, H4, A5, M4, H2, A8, A4, H1, M1, R6, S2, S6 these are high risks present in project. Further analysis, including quantification, and active risk management were needed. Feedback of participants are given below,

Table IV.3 Feedback of participants

Series	Comments
1	Preparing an SOP and conducting meetings, proper site visiting of all the assign member can help to mitigate risks.
2	-
3	-
4	Time to time need to check costing of projects
5	By visiting the site and talking, and sending whatever is on the site on time,

Risk management processes that identify, transfer, and mitigate risks are essential to the success of a project. As a construction manager, deal with risks based on their opportunities and impact. Take a high-probability risk first and then a low-chance risk. To avoid communication problems and disputes, we should document everything. Document the meetings we have with the subcontractors and the customer. Also, keeping all employees on the same page through regular contact via email, phone calls, and text messages. Sharing the project plan with subcontractors so they know which activities need attention.

By following these processes, organization can manage risk effectively:

1. Risk management planning - outlines the process for carrying out risk management initiatives.
2. Risk identification - identification of individual project risks and their sources.
3. Conduct qualitative risk analysis - Assess the likelihood and impact of each project risk to determine its priority.
4. Perform quantitative risk analysis - Risk effect analysis using numbers.
5. Risk Responses plan - develop options, and select strategies, and measures.
6. Monitor and Implement Risk Responses - Execute a risk response strategy that has been agreed upon and oversee execution.

Every organizational member should follow risk management principles to tackle risks effectively:

- a) Value creation: the resources spent to reduce risk must be less than the result of inaction.
- b) Become an integral part of your organizational process.
- c) Participate in the decision-making process.
- d) Clarify uncertainties and assumptions.
- e) Run the systematic process and procedure.
- f) Build on the best information available.
- g) Consider the importance of people.
- h) To be able to constantly improve and enhance.
- i) Be able, adaptable, and responsive to change.

V. CONCLUSION AND FUTURE SCOPE

Conclusion

The level of risk is always linked to the complexity of the project. The fact that there are so many risks that can be identified in the residential renovation sector can be explained by the size and complexity of the project. Several factors can trigger the occurrence of risks. These are often financial and environmental (around site and general project regulations), timing, design, and quality. Other the level of technology used, and the risks of the organization affect the existence of risk. Renovation and remodeling work can be completed throughout the construction phase under a variety of circumstances, posing a significant and high risk to designers and contractors. There are a number of things to take into account that are crucial for house renovation while designing and constructing a residential property. These simple requirements are the general knowledge and experience of designers, contractors, execution team.

Construction companies, corporations that can aid in the development of the project during the design and construction phase, and viewpoints (by supervisor, engineer, and manager) have all presented methods for identifying project hazards that are specific to construction projects.

- The probability-impact matrix was drawn, and high risks were marked. Need a brief mitigation plan to avoid and resolve risks.
- All risks have been recorded and assessed based on their probability of occurrence and their impact on the project for the resolution of risks.
- The project examined several risk factors and some of the consequences are listed below:
- The risk management process begins with the project itself.
- In the future, it will be necessary to keep records of all risks that have been foreseen and prevented. Each organization, large and small, should adopt risk management procedures to minimize the impact of the risks arising from the project and its impact on achieving the project objectives.
- To build improved risk management techniques, there must be strong collaboration amongst all project participants.
- The project manager and the project team should participate in good risk management, including designers, engineers, corporate personnel, contractors, financial management, procurement, evaluation, and project control. The process is continuous, endless loop and repeated detection process, examination, design, management analysis and control. Risk analysis can include defined, estimated, and planned items, new risks, secondary risks, scope changes, change orders, and actual costs, to provide a graphical representation of changes in project risks over time.
- However, Risk management must be a key component of how residential renovation companies manage their projects. In our opinion, residential remodeling businesses in Delhi NCR apply risk management at a moderate to medium level., with slight differences between type, size, risk tolerance of organizations and the experience and tolerance of individuals responding.

Scope for Further Work

From the results,

- It can be said with certainty that most residential renovation projects do not have a systematic procedure for dealing with risks. Risk management takes place in a very informal way.
 - Try other techniques to analyze risks.
 - Try to find out new risk management procedure for residential renovation work.
 - Based on these findings further study, methods for risk selection and risk response strategies recognition are required.
- However, the results above are limited to 05 companies, answers may vary between samples and analytical methods and may be surprising for further research.

This Thesis provides recommendations for administrators in organizations to:

- Create favorable working conditions in your organization.
- Create leadership roles among employees.
- Build a good team in your organization.
- Prepare for proper training to improve performance
- Reduce employee workload through stress management

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