

IDENTIFICATION AND MANAGEMENT OF VARIOUS RISKS INVOLVED IN RESIDENTIAL CONSTRUCTION PROJECTS – A CASE STUDY OF PUNE

Ar. SHWETA RASKAR
Student S.Y.M. Arch
Dr. D. Y. Patil College of
Architecture Akurdi, Pune
(MS) INDIA

MADHAVI KARANGALE
Professor
Dr. D. Y. Patil College of
Architecture Akurdi, Pune
(MS) INDIA

MAHESH BANGAD
Professor
Dr. B. N. College of
Architecture, Pune
(MS) INDIA

ABSTRACT

Risk is defined as an unpredictable event that has the ability to positively or negatively affect a project. It has an impact on a variety of project objectives, including safety, quality, and overall project cost, as well as the environment. Developing Residential projects has a history of being blamed for project failures. This is due to the numerous risks involved in the process. This study aims to identify major risk factors which impacts negatively on the delivery of completion of residential projects. From Literature review, Research Papers and Interviews of experts, 20 risk were identified and rated accordingly score collected by questionnaire.

Keywords - Risk Management, Construction Projects, Risk Identification, Risk Response

1. INTRODUCTION –

In recent years, Construction projects are initiated in complex and dynamic environments. Each construction project is unique and comes with its own set of challenges and opportunities. All construction projects carry certain level of risk.

The PMBOK describes risk as an uncertain event or condition, that if it occurs, has a positive or negative effect on a project's objective. The key element of this definition is that the effect

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of the uncertainty, if it occurs, may be positive or negative on the objectives of the planned endeavor [7]. Project risk management is an essential part of the process which focus at identifying the potential risks associated with a project and responding to those risks.

Risks in the construction industry is always more than compare to other industries. The process of planning, executing and maintaining all project activities is difficult and time-consuming. In construction, risk usually refers to the factors that may affect the objective of the project regarding time, cost and quality. Identification of the risk that can occur is essential for the contractor to get alert and prepare in advance for the uncertainties that arises.

1.2 PURPOSE –

Risk management is an essential part of conducting a residential construction project. Thought many research are already conducted on risk factors affecting in construction industry, it is only working in theory but not in reality as on sites.

The purpose of this research is to reduce the losses which cause due to improper identification and mitigation of risks while constructing residential projects.

1.3 AIM –

The aim of this research is to identify and manage key risk that affect the building construction in residential projects.

1.4 OBJECTIVE –

- To identify risks in residential projects so they could be managed while achieving project objectives
- To study major risk management techniques practiced in managing risks in the construction industry
- To investigate how to deal with risks and uncertainties in phases of the project
- To suggest risk response for identified key-risks

1.5 LIMITATIONS –

Limitations of this study is that it will be covering only the negative Impacts that is threats of Risk and not positive impact or opportunities.

This study will be limited to only residential projects.

2. Literature Review

The literature review was done through internet and journals. The purpose of the literature review is to Identify the Various Risks affected residential construction projects at various locations and to study methods adopted by researcher to rank those identified Risk factors.

2.1 Reference 01 –

"Risks faced by Singapore firms when undertaking construction projects in India." By Ling, Florence Yean Yng, and Linda Hoi. [4]

India is one of the most profitable countries for foreign architectural, engineering and construction (AEC) firms to work in. Rising expectations and salaries which results in increased demand for better quality homes and infrastructure systems, many foreign AEC firms are entering in India. This AEC firms wants to know the risks that they are likely to face before they undertake any project in India. This study focuses on identification of the risks that Singapore-based architecture, engineering and construction (AEC) firms face when working in India.

The methodology used in this study is, based on the literature review, interview questions were designed with the purpose of gathering data on the risk faced and risk response techniques adopted by foreign AEC firms when working in India. A list of 22 Singapore AEC firms that export their services to India which mostly working in big cities, and privately owned building projects, was obtained from the Internet, newspaper articles and government publications from which 10 firms agreed to participate in the study. Interviews were conducted based on the standard list of questions with representatives of the companies in their offices.

The first category of risks comprises political and social risks, economic and financial risks and cultural risks faced by foreign firms when undertaking projects in India. While in second category of risks comprises regulatory, design and construction risks. These risks are faced, regardless of whether a firm is foreign or local.

The study helps to identify the risks that foreign firms face and what measures that may be taken to respond to these risks because foreign firms would then be better prepared for the problems and difficulties that they may encounter in India, and thereby have higher chance of meeting with project success.

2.2 Reference 02 –

"Risk management in construction projects." By Banaitiene, Nerija, and Audrius Banaitis [1]

The construction industry is known to have complexity in its activities and dynamic project environments generating an atmosphere of risks. This paper aims to identify the typical risks involved in residential construction projects which analyzed through a review of literature of various research papers. The study gives us detail concept about Typical Risks on a Construction Project, Definition of Risk and Uncertainty, Risk Management Process and Advantages and limitations of risk management. The methodology used in this paper is literature review of various papers which relate to the concept of risk, risk management in construction as well as methods used in construction industry.

2.3 Reference 03 –

“Risk assessment Model for Residential Construction Projects” by Fergany Mohamed, Badawy Mohamed , Elnawawy [2]

Residential construction industry is highly risk prone, with complex project environment which create an atmosphere of high uncertainty and risk. this paper aims to identify, assessment and rank the significant risks in the residential construction industry in Egypt considering the new economic conditions that have occurred since 2014.

The study gives brief idea about risk identification, summary of risks suggested by literatures, risk assessment model and study of risk factor ranking. 46 risk factors identified from various literatures, which were presented to the experts as a pre-questionnaire in which risks were divided into seven main groups namely; financial risks (F), construction risks (C), environmental risks (E), political risks (P), legal risks (L), management risks (M), physical risks (Ph), and design risks (D). The questionnaire was distributed for 230 experts and from which 200 experts were responded. The project risk assessment model contains an assessment of the probability, the impact for project cost, the impact for project time, risk category, and risk ranking.

As a result of questionnaire, the five most important risk factors in residential projects identified - exchange rate fluctuation, exchange fuel price, change of labor cost, material delivery delay, and change in design from which exchange rate fluctuation, is the most important factor that is placed at rank 1 in this study.

2.4 Reference 04 –

“Critical causes of delay in residential construction projects: case study of central Gujarat region of India.” By Desai, Megha, and Rajiv Bhatt [6]

There are many studies have been carried out to determine the causes of delay in construction projects. Delay is defined as the time difference between the project completion date specified in the contract and the actual project completion date. The objective of this study is

to identify the causes of delay for residential construction projects in Indian context which further proceed to rank identified causes of delay.

59 causes of delays for residential construction projects were identified from literature review which was conducted through books, conference proceedings, internet and international project management journals. Two different techniques for ranking were used, first technique - Relative Importance Index (RII) in which each cause of delay can be calculated, and second technique - Importance index which calculated as a function of frequency and severity index. Total 50 respondents participated in this survey which included 20 developers, 17 contractors and 13 architects/ consultants.

The study concludes that out of top 10 factors total 5 factors were common in ranking by both methods. They were original contract duration is too short, shortage of labors, delay in material delivery, low productivity level of labors, delay In Progress payments by owner.

2.5 Reference 05 –

“Risk Management in Construction Projects as Per Indian Scenario” [5]

Effective risk management strategies can help you reduce risks and maximize opportunities and securing a successful project process. The study focusses on concepts of risk management which covers the related literature on the topic, development of a survey questionnaire and suggestions related to risk management practices in construction industry. The aim of this study is to identify and assess the risks and uncertainties in the construction industry around the globe, and to evaluate the current state of risk management practices and make a basis for future studies for development of a framework for effective risk management which can be adopted by developers and contractors.

History, Management Stability, Staff expertise and experience, Team Size, Resource Availability, Time Compression and Complexity are the Several factors expose projects to normal than higher risk. Risks associated with the construction industry can be broadly categorized into technical risks, Logistical risks, Management related risks, Environmental risks, financial risks and Socio-political risks. This study comprises of the common sources of risks in construction industry, Major processes of Project Risk Management, Response to Risk and Advantages of Risk Management.

Methodology used as, A questionnaire was developed studying literature on construction risk management and A conversation was held with construction industry personnel in order to identify and assess the risk factors associated with the construction business. The study is totally theoretical based and findings says that the most utilized risk response measures are risk elimination and risk transfer. However, respondents interviewed for the study revealed that lack of innovation leads to delays in projects, unacceptable quality and low productivity.

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3. METHODOLOGY -

In this paper, Questionnaire survey and Case study method was used to collect the data. A discussion was made with different stakeholders, working for the construction industry to identify and assess, the risk factors relating to residential construction industry.



4.

CASE STUDY –

4.1 Project 1

Table 1. Project-1 Description

| | |
|-------------------|---------------|
| Location | Ravet, Pune |
| Type of Project | Residential |
| Area of Plot | 3250 sq.m. |
| No. of Floors | LG+UP+11 |
| No. of Flats | 130 |
| Start Date | November 2018 |
| End Date | December 2020 |
| Actual Finish | February 2022 |
| Impacted Duration | 14 Months |

Table 2. Risk factors and their impacts with Risk response plan

| Sr. No. | Risk Factor | Description | Impact | Response Plan |
|---------|-----------------------------------|--|---|---|
| 1 | Financial Risk | No bookings in (Covid - 19) Lockdown Period | Project delayed due to lack of funding | |
| | | Cost – Overrun Because of 30% Increase in Construction rate, Increase in Labor Rate, Inflation | Cost Overrun by 8 crore 58 lac | Flat rate increased by 15%, change in Material, Reuse of Material |
| 2. | Force Measure – Covid 19 Pandemic | Delay in Revision of Sanction drawing, Labor shortage, No Bookings | Project totally stopped for 9 Months | Accepted the situation |
| 3. | Physical Risk | Unskilled Labor, Poor Safety | Labor Injury | Penalty of Rs. 25,000 to Contractor |
| 4. | External Risk | Heavy Rain Effect | Delay in Construction | Increase in Manpower to stick to the schedule |
| 5. | Design Risk | One extra floor added after revision in drawing. | Jacketing of 14 columns was done for strengthening purpose which impacted on schedule of the project. | Increase in Manpower to stick to the schedule |
| | | Delay in Providing structural drawings on site | Change in schedule | Accepted the situation as extra floor was not planned before |

4.2

Project 2 –

Table 3. Project-2 Description

| | |
|-------------------|--------------|
| Location | Ravet, Pune |
| Type of Project | Residential |
| Area of Plot | 1250 sq.m. |
| No. of Floors | P+7 |
| No. of Flats | 49 |
| Start Date | October 2017 |
| End Date | April 2019 |
| Actual Finish | March 2020 |
| Impacted Duration | 11 Months |

Table 4. Risk factors and their impacts with Risk response plan

| Sr. No. | Risk Factor | Description | Impact | Response Plan |
|---------|-------------------------|--|--|---|
| 1 | Legal Risk | No bookings due to negative impact by previous owner | No bookings cause delayed in construction | Hoardings were installed at various locations for publicity purpose |
| 2. | Project Management Risk | Owner was not available when his decision was needed for change in order | Delayed in construction because of pending decisions | Accepted the situation |
| 3. | Labor Risk | Poor Workmanship, change in labor, lack of communication skills | Correction because of errors in construction impacted delay in work progress | Plan interviews to hire skill labors for Major work |
| 4. | External Risk | Heavy Rain Effect | Delayed in Schedule of Construction | Increase in number of labors and work hours to stay on track |

5 Questionnaire –

This study follows a step-by-step methodology which started with identifying the risks followed by data collection from various sources like Research Papers and Articles.

The questionnaire was created utilizing data from prior studies on risk factors that influenced the construction project's development. The Relative Importance Index (RII) is used to analyze the causes and effects of risks involved in residential construction projects.

The Relative Importance Index (RII) approach used to describe the relative importance of the specific causes and effects based on the likelihood of occurrence and effect on the project using the Likert scale of five scales. In addition, the higher value of the index of relative importance (RII) is the critical cause or impact component and is determined by equation -

$$RII = \sum W / A * N$$

Where:

1. RII – is Relative Importance Index
2. W – is the weight given to each factor by the respondents from 1, 2, 3, 4 and 5 for very low, low, moderate, high and very high, respectively
3. A – is the highest weight (i.e., 5 in this case), and;
4. N – is the total number of respondents.

5.1 Questionnaire Respondents –

Table 5. Questionnaire Response

| Position | No. |
|-----------------|-----|
| Project Manager | 4 |
| Architect | 7 |
| Engineer | 1 |
| Contractor | 1 |

4.3 Calculation of Risk Factor

Table 6. Questionnaire Response

| No. | Risk Factor | Risk Probability | | Risk Impact | | Overall | |
|-----|--|------------------|------|-------------|------|---------|------|
| | | R II | Rank | R II | Rank | R II | Rank |
| 1. | Inflation after Covid 19 | 0.738 | 1 | 0.784 | 2 | 0.578 | 1 |
| 2. | Delayed owner payments | 0.676 | 4 | 0.769 | 3 | 0.519 | 5 |
| 3. | Bribery/Corruption during land acquisition and project approval phase | 0.615 | 6 | 0.646 | 8 | 0.397 | 12 |
| 4. | Improper Management of Project Funding before execution of the project | 0.630 | 5 | 0.753 | 4 | 0.474 | 6 |

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| | | | | | | | |
|-----|---|-------|----|-------|----|-------|----|
| 5. | Changes in Regulation for Approvals | 0.446 | | 0.676 | 6 | 0.301 | 19 |
| 6. | Unfamiliar With Local Social Element Scenario | 0.584 | 8 | 0.630 | 9 | 0.367 | 13 |
| 7. | Delay due to various permissions to be obtained from Authorities for High Rise Residential Construction | 0.723 | 2 | 0.753 | 4 | 0.544 | 4 |
| 8. | Instability in politics | 0.553 | 9 | 0.630 | 9 | 0.348 | 16 |
| 9. | Land Acquisition | 0.600 | 7 | 0.676 | 6 | 0.405 | 11 |
| 10. | Change in Weather Conditions | 0.553 | 9 | 0.553 | 12 | 0.305 | 18 |
| 11. | Design process takes longer than anticipated | 0.553 | 9 | 0.661 | 7 | 0.365 | 14 |
| 12. | Insufficient data collection and survey before design (E.g., Unaware of steep contour on site) | 0.615 | 6 | 0.753 | 4 | 0.463 | 7 |
| 13. | Improper Project Planning and Budgeting | 0.707 | 3 | 0.784 | 1 | 0.554 | 2 |
| 14. | Improper Resource management | 0.630 | 5 | 0.707 | 5 | 0.445 | 9 |
| 15. | The increase in labor cost | 0.584 | 8 | 0.753 | 4 | 0.439 | 10 |
| 16. | Material delivery delay (steel, bricks...) | 0.584 | 8 | 0.615 | 10 | 0.359 | 15 |
| 17. | Equipment breakdowns, Shortage of equipment | 0.507 | 10 | 0.569 | 11 | 0.288 | 20 |
| 18. | Shortage of labors | 0.600 | 7 | 0.753 | 4 | 0.451 | 8 |
| 19. | Unskilled labors results in poor quality of work | 0.676 | 4 | 0.815 | 1 | 0.550 | 3 |
| 20. | Labor Injury | 0.507 | 10 | 0.646 | 8 | 0.327 | 17 |

5 Recommendation –

Table 7. Risk Factors and their measures

| Risk Factor | Measures |
|--|---|
| <p>Inflation – <i>Due to inflation the building material prices, labor wages and machinery hire rates changes every year, resulting in the project's initial budget being deviated from the final budget.</i></p> | <ol style="list-style-type: none"> 1. Accurate planning estimates and the assistance of financial advisors 2. Develop a technique for formulating the budget at the start of the project by considering the inflation aspect before finalizing the budget estimation. |
| <p>Delayed Owner Payments –</p> <ul style="list-style-type: none"> • Owners' poor financial management. • Owners' poor financial sources/condition • Owners' disagreeing on the valuation of work done | <ol style="list-style-type: none"> 1. Follow-up with clients using formal procedure. 2. Follow-up with clients by direct communication only. 3. Creating payment departments for each contractor to report any issues with late payments This department would be responsible for keeping records of every Owner/client with a history of delayed payments. These owner/clients would be subject to penalties if they fail to pay on time as stipulated in the contract. |
| <p>Improper Management of Project Funding before execution of the project-</p> | <ol style="list-style-type: none"> 1. First Estimate the exact costs for which we need to forecast the total amount of people, equipment, materials and other resources needed to complete the work. This will help to analyze that how much funding we are going to need to arrange it before execution. 2. Determine if you can get contingency funding |
| <p>Changes in Regulation for Approvals – <i>For Example – New UDCPR introduced in 2020</i></p> | <ol style="list-style-type: none"> 1. Study in detail initial copy of new regulations before it come to effect. Understand the changes, check if any revision needed, and be prepared early with revision drawings which will help to save time over-run of the project. |
| <p>Unfamiliar With Local Social Element Scenario</p> | <p>Respective person keep updated regularly for changes occur in local surroundings</p> |
| <p>Delay due to various permissions to be obtained from Authorities for High Rise Residential Construction</p> | <ol style="list-style-type: none"> 1. Create timeline, hire Experienced Consultants for various approvals like EC. 2. Finalize drawings before taking approvals, so no |

| | |
|--|---|
| | <p>revision will need again and again.</p> <ol style="list-style-type: none"> 3. Start Execution only after receiving all approvals and NOC's. |
| <p>Instability in politics –</p> <ul style="list-style-type: none"> • <i>corruption</i> • <i>changes in policies</i> • <i>protest marches or events leading to work closures</i> | <ol style="list-style-type: none"> 1. Information can be obtained initially from Internet and news or conducting market research to make correct decisions for progress of work. 2. Building proper relations with local politicians |
| <p>Change in Weather Conditions</p> <ul style="list-style-type: none"> • <i>Example- Heavy Rain, Cyclone)</i> | <ol style="list-style-type: none"> 1. In case of heavy rain delay in slab construction can be adjusted in next slab by increasing manpower and working hours 2. Respective person must be updated regularly, for weather condition and take precautions accordingly. 3. be sure to keep an eye on local predictions to make allowances for poor weather days when planning your timeline |
| <p>Design process takes longer than anticipated</p> <ul style="list-style-type: none"> • <i>Contains detailed plans and specifications</i> | <ol style="list-style-type: none"> 1. Create timeline for design Preparation 2. Make timely reviews and approvals from client 3. Hire experienced architect as per project scope |
| <p>Insufficient data collection and survey before design</p> <ul style="list-style-type: none"> • <i>Example - Unaware of steep contour on site</i> • <i>Unviability of electricity on site</i> • <i>Unaware of soil condition</i> | <ol style="list-style-type: none"> 1. Make sure to visit site before start design. 2. Check if all services are there (Access, Water, Electricity) 3. For Large scheme hire surveyor for detail contour drawing before design process |
| <p>Improper Project Planning and Budgeting</p> <ul style="list-style-type: none"> • <i>Include resource planning, time planning, financial planning, equipment and site management</i> | <ol style="list-style-type: none"> 1. The high-rise construction manager should have an excellent knowledge of delays that may happen and should plan and utilize an efficient management system to address those delays. 2. Use a real-time tracking tool to stay on top of your construction schedule and increase productivity. Check in regularly during the construction phase and request for daily reports so that you can adjust deadlines and costs as you go. 3. Project Manager should take estimates from multiple vendors and select the most economical one. |

| | |
|---|---|
| <p>Improper Resource management</p> <p>–</p> <ul style="list-style-type: none"> • <i>Not assigning right people to the task</i> • <i>Overburden</i> • <i>Right material not delivered at right time</i> | <ol style="list-style-type: none"> 1. Implement resource management software to manage and track the schedules of resources and projects. Make sure to hire right resource for that job |
| <p>The increase in labor cost –</p> <ul style="list-style-type: none"> • <i>xample – Labor cost increased after pandemic period</i> | <ol style="list-style-type: none"> 1. Increased cost can be adjusted by increasing the rate of flat by same amount 2. Save Fundings by using different techniques like – use of existing resources and purchasing only those which are really needed or using material which is good but cheaper than planned material etc. |
| <p>Material delivery delay</p> | <ol style="list-style-type: none"> 1. Taking early Control of the Material Suppliers is Key for avoiding any potential delays on their deliveries 2. Use ERP software for Material Management to avoid delay in ordering materials. |
| <p>Equipment breakdowns, Shortage of equipment –</p> <ul style="list-style-type: none"> • <i>Improper operation</i> • <i>Maintenance delay</i> | <ol style="list-style-type: none"> 1. Provide required Training to use equipment properly 2. Perform Regular Inspections 2. Always be ready with backup plan on site |
| <p>Shortage of labors –</p> <ul style="list-style-type: none"> • <i>Due to Pandemic</i> • <i>Because of recession</i> • <i>language barrier in the hiring and training process.</i> | <ol style="list-style-type: none"> 1. Provide Shelter and other amenities for labors at site only so there are less chances to lose labors 2. Support labors with mental and physical health resources like career counseling, and reskilling programs which can help attract job seekers 3. While selecting sub-contractor verify whether they have sufficient labor resources to complete the work |
| <p>Unskilled labors results in poor quality of work –</p> <ul style="list-style-type: none"> • <i>Lack of Basic Skills</i> • <i>Increase in accidents on site</i> | <ol style="list-style-type: none"> 1. Use construction materials which reduce the need for skilled labor 3. Find fresh talent and provide training |
| <p>Labor Injury</p> | <ol style="list-style-type: none"> 1. Provide training to avoid accidents 2. Penalty to sub contactor if his labor is not carrying safety equipment's. 2. Make sure to use net on the periphery of the building when building reach to 15 m height |

5 CONCLUSION –

Construction Industry is highly prone to risks and therefore management of those risks must be taken into consideration in the decision process.

In this study, Cost-Overrun and delays in construction projects in Pune city are studied through case studies and a questionnaire survey. 20 number Risks were identified through the Research Papers and Articles, which were presented through questionnaires among 20 experts from which 13 experts responded. Experts were asked to rate those risks on a scale of 1 to 5, for the Probability of occurrence of Risk and the Impact of Risk on cost overrun and delay. The Risk ranking is carried out by using the method of the Relative Importance Index.

From the ranking process, it was found that Inflation, Improper Project Planning and Budgeting, Improper Management of Project Funding before execution of the project, and The increase in labor cost are highly rated risks that resulted in cost overrun of the project, while Delay due to various permissions to be obtained from Authorities for High Rise Residential Construction, Delayed owner payments, Insufficient data collection and survey before design, Shortage of labors and Improper Resource management are the factors which majorly effect on the time schedule of the project.

Some risks were found to be difficult to reduce. This includes risk like force measure which affected the project with delay in Revision of Sanction drawing, Labor shortage, No Bookings in lockdown period, another risk is Design risk in which one extra floor were added after new regulations, which results in the time overrun of project.

It was also found, from discussion with project manager that, in many residential projects even if those are high rise, risk assessment is not carried out which in turn always results in the delay of the project.

In this study, it was found that the number of risks involved during the construction of the project are large, and if not mitigated properly, the probability of successful completion of the project within the required time and cost frame will reduce.

RECOMMENDATION FOR FUTURE SCOPE OF RESEARCH –

There is many research have been carried out on risk management in construction industry. But number of research on Residential construction risk analysis are very few. The following are a few areas for future research –

1. What additional tools we can use to identify risk priorly in Residential Construction Project?
2. What are the measures that can undertake to reduce political risk in Pune?

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3. How is the risk of inflation can be managed correctly in India?
4. How are residential construction delays overcome or handled?

Appendix 1. Interview Questions –

Below are the Risks which are Identified in the Construction work of Residential Projects. Please fill the 'Probability of Risk Occurrence' from very low to very high and its 'Impact level' on the Residential construction Projects from very low to very high.

1. Inflation after Covid 19-

- Probability of occurrence of the risk factor
1. Very low 2. Low 3. Medium 4. High 5. Very high
- Impact of this factor on project cost, schedule
1. Very low 2. Low 3. Medium 4. High 5. Very high

2. Improper Management of Project Funding before execution of the project –

- Probability of occurrence of the risk factor
1. Very low 2. Low 3. Medium 4. High 5. Very high
- Impact of this factor on project cost, schedule
1. Very low 2. Low 3. Medium 4. High 5. Very high

3. Changes in Regulation for Approvals –

- Probability of occurrence of the risk factor
1. Very low 2. Low 3. Medium 4. High 5. Very high
- Impact of this factor on project cost, schedule
1. Very low 2. Low 3. Medium 4. High 5. Very high

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