

**RISK MANAGEMENT IN CONSTRUCTION PROJECTS**Arpit Gupta¹, Panchal Akshay², Pandya Nidhi³, Parmar Shreya⁴, Vaghela Ashwini⁵¹ Assistant Professor, Civil Engineering Department, Gujarat, India² Student, Civil Engineering Department, Gujarat, India³ Student, Civil Engineering Department, Gujarat, India⁴ Student, Civil Engineering Department, Gujarat, India⁵ Student, Civil Engineering Department, Gujarat, India

Abstract:- Managing risks in construction projects has been recognized as a very important management process in order to achieve the project objectives in terms of time, cost, quality, safety and environmental sustainability. However, until now most research has focused on some aspects of construction risk management rather than using a systematic and holistic approach to identify risks and analyze the likelihood of occurrence and impacts of these risks. This project aims to identify and analyze the risks associated with the development of construction projects from project stockholder and life cycle perspectives. Postal questionnaire surveys were used to collect data. This research found that risks spread through the whole project life cycle and many risks occur at more than one phase, with the construction stage as the most risky phase, followed by the feasibility stage.

KeyWords: risk, risk management, construction projects, life cycle, stake-holders perspectives etc...

1 Introduction**1.1 General**

Construction projects are usually characterized by many varying risks. Being able to manage risks throughout the construction process is an important and central element preventing unwanted consequences. Risk management is also decisive for achieving a good final result with secure economy. Many different actors are involved in a construction project and often they have no or limited experience of earlier collaboration with each other. In many projects there is an attempt by actors to try to avoid risks as far as possible and let somebody else in the value chain deal with them.

1.2 Objective of Study:

- To study the different phases of construction industries and find out the risks associated with each phases.
- To analyze the all risks in each phase and find out the most vulnerable risk for each phase.
- To discover the probable measures and precautions to avoid or to tackle with the vulnerable risks of each phase for project safety.

1.3 Scope of work

The research work is limited up to construction industry of Godhra and Halol City and nearby vicinity.

The analysis will be done using RII (RELATIVE IMPORTANT INDEX) & IMPI technique

The data for this study are collected through field survey from the contractor, the consultant, the architect and the structural engineer.

2. Define Risk**2.1 What is "Risk"?**

The meaning of the term "risk" must be clearly for effective project risk management. In the context of a project, we are concerned about potential impacts on project objectives such as cost and time. A general definition of "Risk" in this context is Risk is an uncertainty that matters; it can affect project objectives negatively or positively. The uncertainty may be about a future event that may or may not happen and the unknown magnitude of the impact on project objectives if it does happen. Thus, a "risk" is characterized by its probability of occurrence and its uncertain impact on project objectives. The kinds of risks appearing in a risk register are shown below based on when they might occur during the life cycle of a project.

Throughout the project life cycle, a future event that may occur at any time in a project's lifecycle is a risk. It has a probability of occurrence and an uncertain in impact if it does occur. During Planning and Design, uncertainty in the total cost estimate, due to uncertain quantities and unit prices is a risk. In this case the probability is 100 % (the estimate and its uncertainties exist), and the uncertainties impact the project cost.

During construction, a Notice of Potential Claim (NOPC) has a probability of becoming a Contract Change Order (CCO) and an uncertain cost/time impact if this happens. This risk is retired from the register if the claim is dismissed or if it is replaced by a CCO.

During construction, a CCO which has occurred (100% probability) is a risk, but its cost/time impact may be uncertain. If there is an estimate in the CCO Logo the project, the uncertainty is expressed as a range around the estimate. This risk is retired from the register when the CCO is executed with the contractor. These examples are collectively referred to as "risks" in this report, and would all be included, when applicable, in the projects risk register because they contain uncertainty that affects project objectives.

2.2 What is risk management?

Risk management is a process of thinking systematically about all possible risks, problems or disasters before they happen and setting up procedures that will avoid the risk, or minimize its impact, or cope with its impact. It is basically setting up a process where you can identify the risk and set up a strategy to control or deal with it. It is also about making a realistic evaluation of the true level of risk. The chance of a tidal wave taking out your annual beach picnic is fairly slim. The chance of your group's bus being involved in a road accident is a bit more pressing.

2.3 Methods of Risk Management

1) Risk Assessment Methods and Application in the Construction Project:

DR. R.K.KANSAL, MANOJ SHARMA, May-June 2012

The purpose of this study is to assess the use and method of risk identification techniques in the construction industry. They are classified in specialized industrial construction infrastructure and heavy construction. They conducted a survey research by applying a questionnaire among in the construction industry. The risk identification techniques more frequently apply in construction are check- list flowchart, brain storming, Delphi method, etc.

2) Dynamic risk management of construction projects using tailor-made risk breakdown structures:

Prof. Mehdizadeh Rasool

They have developed a methodology for generation of tailor-made Risk Breakdown Structure which are adapted to several constrains:

Adaptability to the stage and development of the project,

Ability to represent the project when viewed from different perspectives,

Prototype software has been developed which is based on an evolutionary risk database and provides a friendly interface for the user.

The methodology has been applied to two specific cases: tunneling project and temporary structures.

3) Identifying Key Risks In Construction Projects: Life Cycle and Stakeholder Perspectives

DrPatrick. X.W. Zou, DrGuomin Zhang, Professor Jia-Yuan Wang

This research endeavored to identify key risks associated with the achievement of all project objectives in terms of cost, time, quality, environment and safety.

On the basis of a survey with industry practitioners owning robust experience and knowledge of construction projects, 20 key risks were highlighted on a comprehensive assessment of their likelihood of occurrence and level of impacts on project objectives

4) Typical Risks in Building Projects Uncertainty Analysis In Construction Project's Appraisal Phase L. Ustinovičius, D. Migilinskas, J. Tamošaitienė, E.K. Zavadskas:

This article deals with risk and uncertainties encountered during the appraisal process in construction, as well as with reasons of their origin.

An analysis of three equal size buildings' appraisal has been carried out at different stages of building implementation. Factors of different phases have been established and change tendencies of these factors have been identified.

Different projects bring different risks to consider, although, among different types of risks in the projects, the typical construction risks can be distinguished with the groups and classification according to the allocation in individual project phases.

2.4 Risk in Different Construction Phases

Conceptual design Phase

The conceptual design phase is the initial phase of the building project. Most important decisions about the planning, organization, design and type of contract takes place in this stage. The initial ideas about the project turn out in various concepts.

Preliminary Design

After the conceptual design phase, where one concept is chosen, this is further analyzed, taking into consideration technical requirements. More details are considered, a project brief is developed, and preliminary cost estimation is prepared in order to assess the economy of the project and of the chosen solution. The concept is not a ready project in this phase, still detailed studies are going to be done to identify potential risks, plan for a proper organization and prepare a sufficient space for changes.

Detailed Design

The detailed design is the next task to solve after the final concept has been chosen and the preliminary design has determined the initial cost and 'constructability' of the project. The designers use information from the final concept evaluation in order to prepare final drawings, select materials, determine component sizes, determine methods of construction et cetera, in order to make the project cleared and ready to implement and construct. The technical specification and requirements together with drawings are the set of documents for potential contractor.

Construction Phase

The selection of a contractor is the initial part of this phase. Depending on the form of the project roles and responsibilities of the contractor are prescribed. After the contractor has been selected, the necessary agreements, licenses and insurances must be secured. The critical events and risks in this point depend on the type of construction. The construction phase should be carefully planned and placed in time and duration of the project. Each delay is connected with money, which the contractor has to pay to the client.

3. Types of Risk

3.1 Act of God

- **Flood**



- **Earthquake**



- **Landslide**



- **Fire**



- **Wind damage**

3.2 Physical

- **Damage to Structure**



- **Damage to equipment**



- **Labour injuries**





- Fire

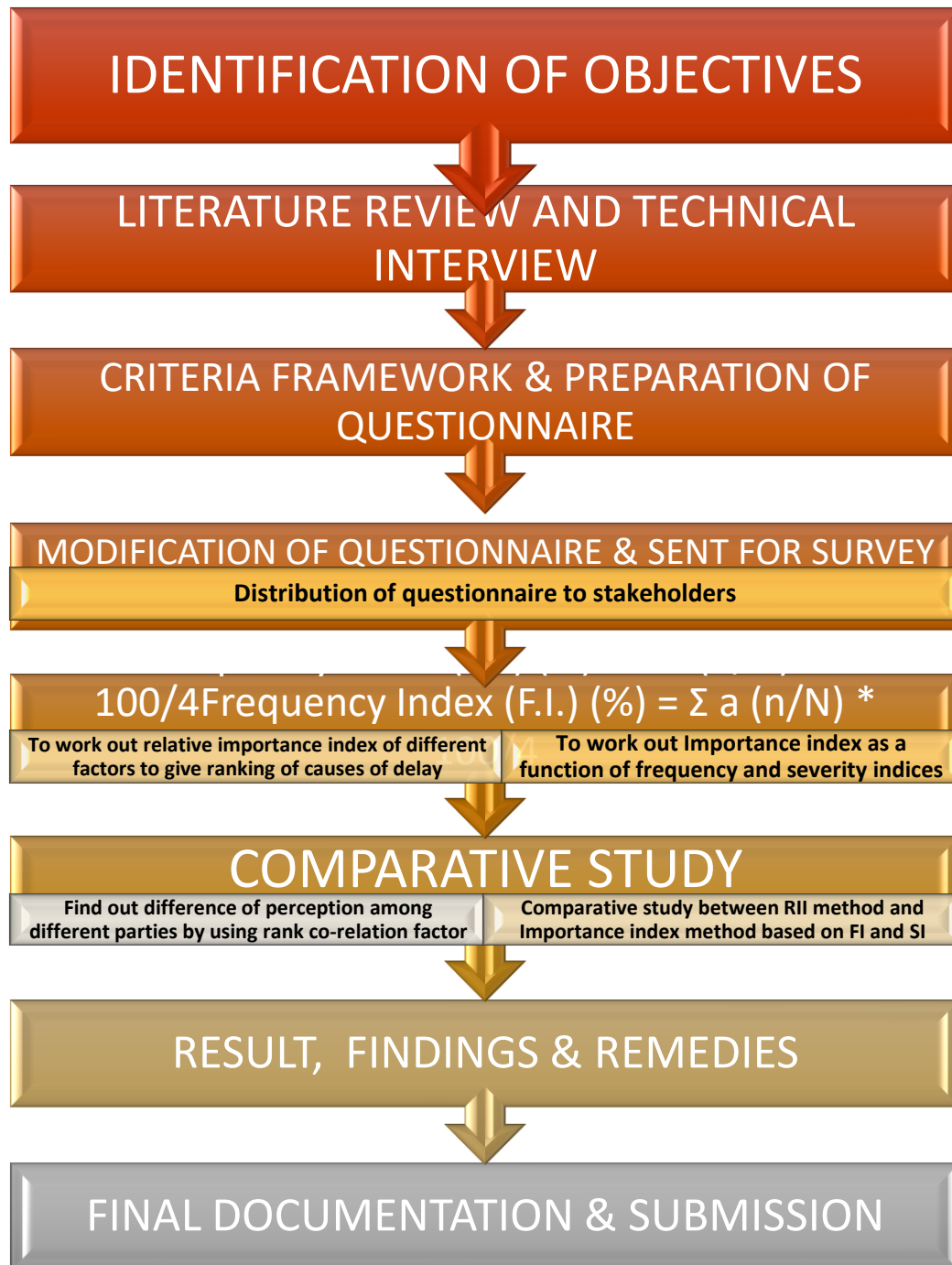


- Theft



4. Methodology of Work

FLOW CHART OF RESEARCH METHOD



Basically, this research work includes eight different sections. First section of research covers the identification of the objectives. Second section of research covers review of literatures. Third section of research includes development of framework for ranking of the risk events in residential construction project. Fourth section includes data that has to be collect and framework has to be established. Fifth section of research includes analysis of collected data. In this phase data analysis was done by two different techniques to rank the risk events.

In first technique relative importance index is calculated for each risk while in second technique importance index as a function of frequency index and severity index is calculated for each risk. Sixth section covers discussion on the ranking of the importance of risk events among different parties. For this purpose, spearman’s rank correlation test was used. This section covers comparative studies between two different techniques based on results. Seventh stage of research covers conclusion and recommendation part. Eighth section covers the documentation of the research. Data Analysis Approach

The collected data were analyzed through the following statistical techniques and indices:

The Relative Importance Index (RII) will be used to rank (R) the different risks. These rankings make it possible to cross-compare the relative importance of the factors as perceived by the four groups of respondents (i.e. Architect, Contractors, Builder/Developer and Structural Engineer). Each individual risks's RII perceived by all respondents will be used to assess the general and overall rankings in order to give an overall picture of the risks of construction in Indian construction industry.

This RII technique is used by many researchers like Fugar et al., (2010) ,Kometa et al.,(1994) to rank the causes of delay in construction projects of Ghana. The formula to calculate RII given below:

$$RII = \frac{\sum W}{AN}$$

Where,

W = Weighting given to each factor by the respondents (ranging from 1 to 4),

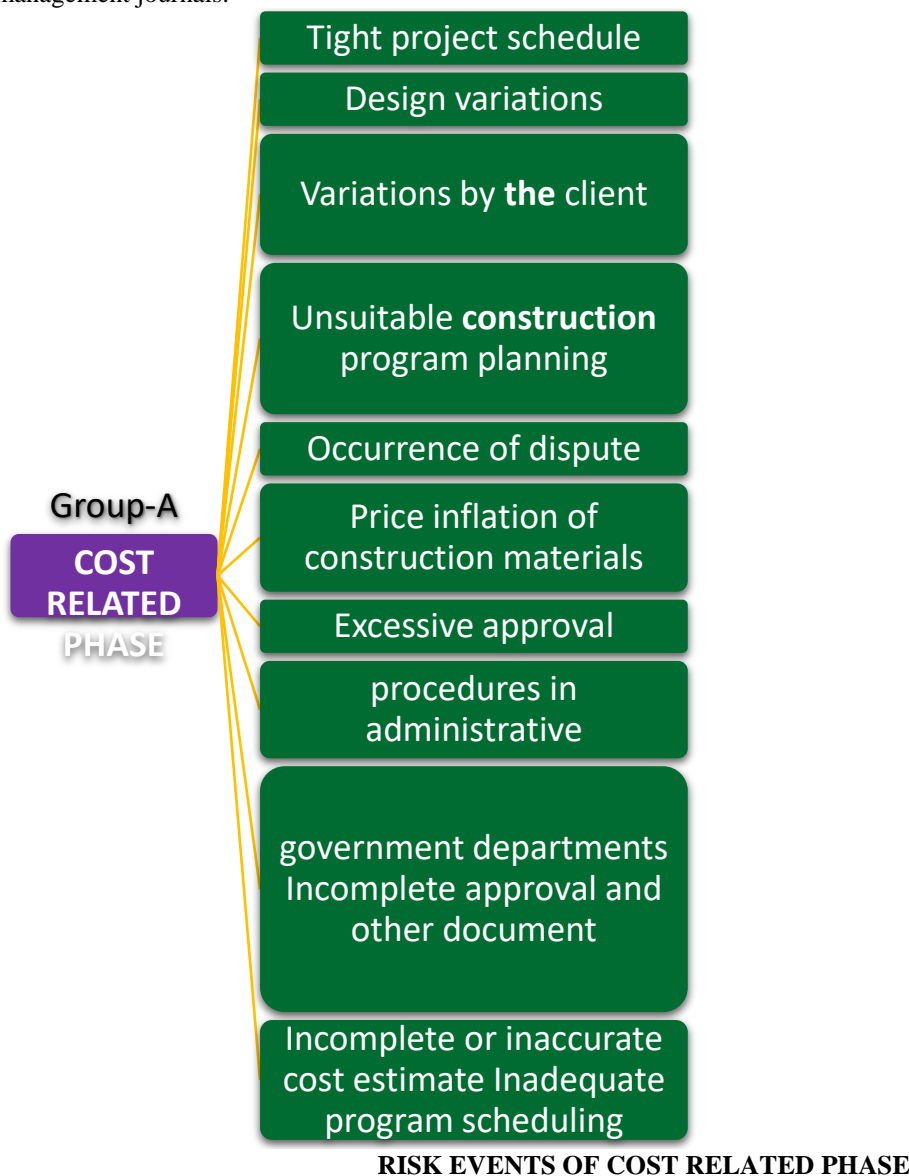
A = Highest weight (i.e. 4 in this case),

N = Total Number of respondents.

4.1 Development of Criteria framework:

The objectives defined in the preceding section were achieved through the accomplishment of the following tasks: The preliminary data for this research was collected through a literature review and the use of a questionnaire survey targeted at some contractors, architect and consultants in some projects in India.

The literature review was conducted through books, conference proceedings, the Internet, and international project management journals.



5. Data Collection

5.1 Data distribution and collection

First of all, list of the stakeholders was generated from local survey and the internet through their websites and accordingly questionnaires were distributed to various stakeholders by going personally or through email. Personal interview and mail back techniques were used in this research, where respondents had a clear opportunity to take part or not; therefore, the voluntary participation in research was ensured.

The questionnaire was designed in such a way that no participant would be identified personally from any part of the questionnaire. Privacy, confidentiality and anonymity were preserved. The telephone number, e-mail contacts and address of researcher were given at the end of the questionnaire for contact regarding any query as well as for sending back the response. The questionnaire was distributed to various stakeholders by informing them regarding the purpose of the research and asking them about their willingness to participate in the research.

Once the initial willingness was shown by the architects, a questionnaire was given to them. Total 108 questionnaires were distributed to different respondents in Godhra and Halol City, Gujarat. List of the stakeholders (108) whom questionnaire was distributed is given as above. They were sent the reminder for sending their feedback after 10 to 15 days of sending the questionnaire. This study received 53 responses. So, the response rate in this research is 49.07%. Due to constraint of time limit, this study could not collect the responses as per sample size requirement.

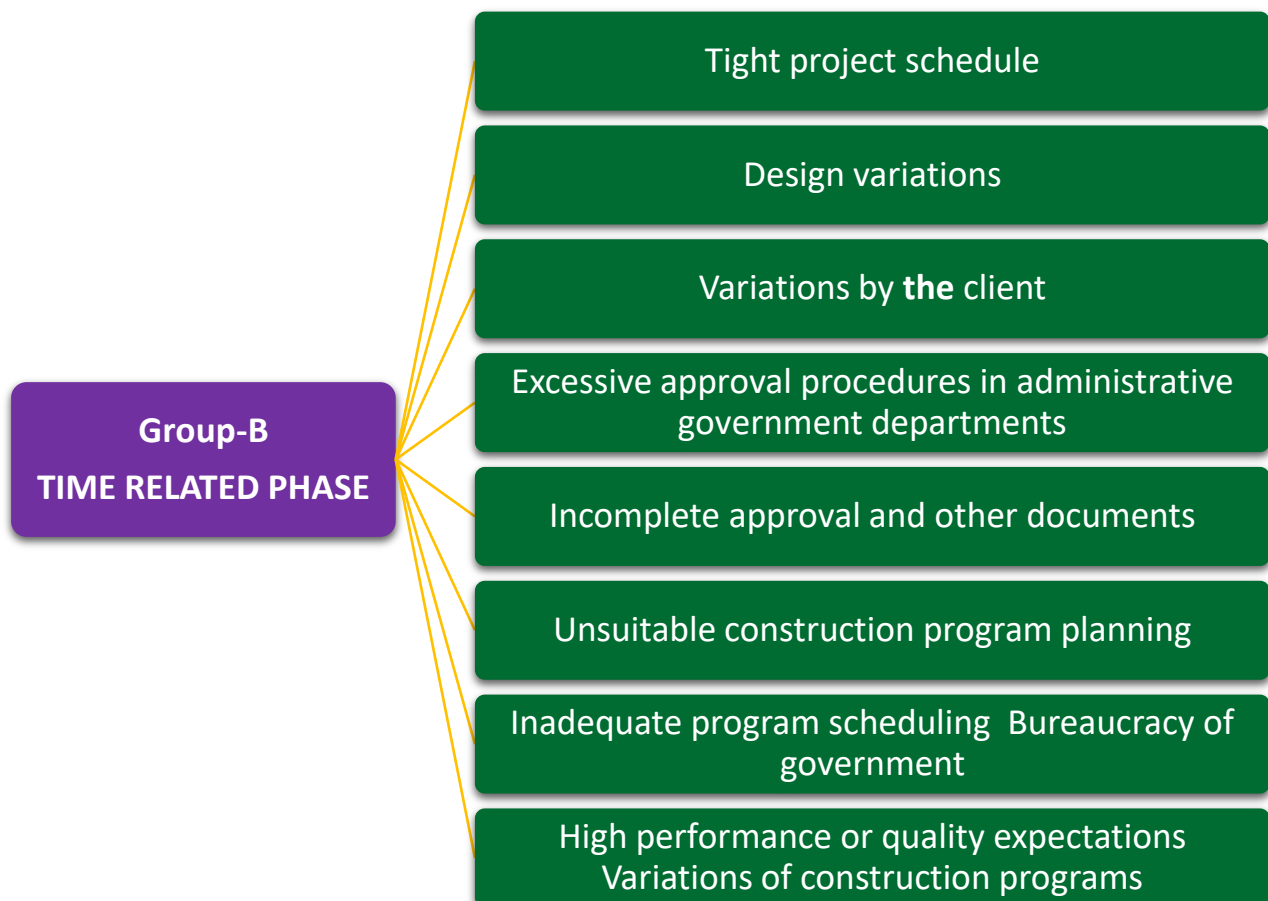


Table 5.1 Percentage of questionnaire distributed and responses received of Architect

City	Questionnaire Distributed	Questionnaire Received	% Of Responses
Godhra	18	09	50.00
Halol	10	06	60.00
Total Response From Architect	28	15	53.57

Table 5.2 Percentage of questionnaire distributed and responses received of Contractor

City	Questionnaire Distributed	Questionnaire Received	% Of Responses
Godhra	20	11	55.89
Halol	10	05	50.00
Total Response From Contractor	30	15	50

Table 5.3 Percentage of questionnaire distributed and responses received of Developer

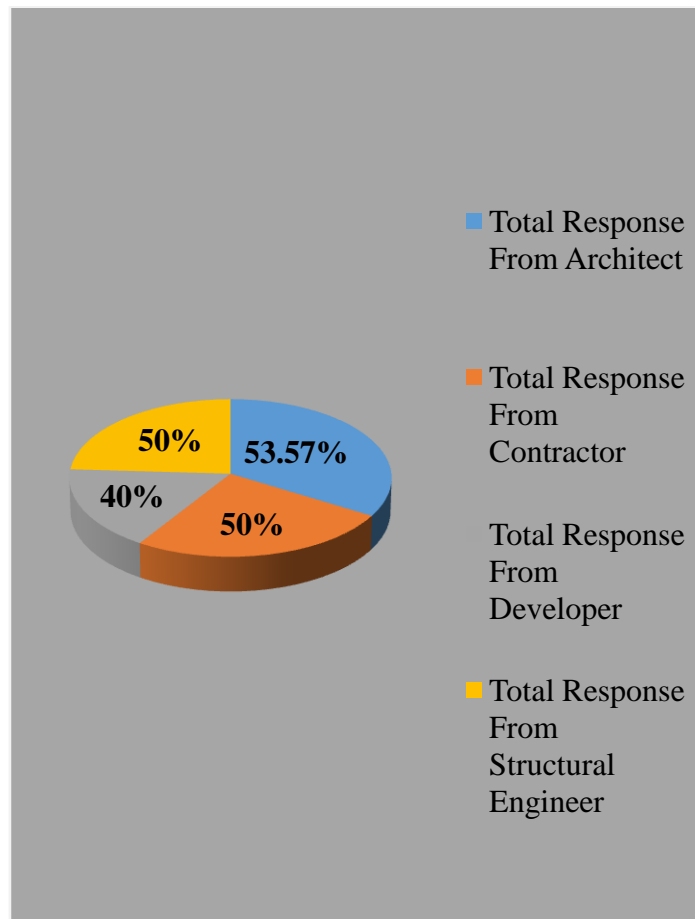
City	Questionnaire Distributed	Questionnaire Received	% Of Responses
Godhra	13	05	38.46
Halol	07	03	42.85
Total Response From Developer	20	08	40.00

Table 5.4 Percentage of questionnaire distributed and responses received of Structural Engineer

City	Questionnaire Distributed	Questionnaire Received	% Of Responses
Godhra	19	11	57.89
Halol	11	04	36.36
Total Response From Structural Engineer	30	15	50

Table 5.5 Total Percentage of questionnaire distributed and responses received

Sr. No	Respondent	Questionnaire Distributed	Responses Received	% of Responses
1	Architect	28	15	53.57%
2	Contractor	30	15	50%
3	Developer	20	08	40%
4	Structural Engineer	30	15	50%
	Total	108	53	49.07%



6. Data analysis methods

6.1 RII technique

The procedure used in analyzing the results was aimed at establishing the relative importance of the various risk events responsible for project failure by giving rank to the risk event by RII technique. The questionnaire gave each respondent an opportunity to identify the factor that was likely to risks by giving the response “very important, important.....etc.”

6.2IMPI technique:

In this method of analyzing data, for each risk event two questions were asked to find out Frequency Index and Severity Index and on basis of this Importance index is calculated for ranking to risks. These two questions were what is the frequency of occurrence for this risk? And what is the degree of severity of this risk on project delay? Both frequency of occurrence and severity were categorized on a four-point scale.

Table 6.1 Top 10 risks ranked by Relative Importance Index (RII) technique

RA NK	RISK EVENTS
1	Poor or defective design due to using inappropriate design parameters
1	Poor design check by consultant regarding the level of complexity and type of construction
2	Mistake in design
3	Design process doesn't include sensitivity study to assess the impact of natural hazards
4	Consultant is not informed about the changes in project
4	Complexity of project time management due to complex nature of the project

5	Delay in contract issue by owner of the project
6	Imposed unrealistic time planning for project due to insufficient or incorrect information
6	Conflict of laws related to one of contract clauses (laws are not consistent)
6	Poor time Management due to change of manager or management strategies of the project
7	misunderstanding of drawings and specifications
8	Design changes at this stage
9	Litigation conflict with neighbour of the project
10	Poor design check by consultant regarding the level of risks for project works and/or third party

Conclusion

Comparison of top 10 Risks by both methods (RII and IMPI)

The relative importance index and importance index explained earlier were used to rank delay causes from view point of three parties (developer, contractor, and architect). These results are based on analysis of data of all respondent. The table 7.1 shows top 10 causes agreed by all three parties by both methods. The Results shows that out of top 10 factors, 6 factors were common in ranking by both methods.

They were Conflict of laws related to one of contract clauses (laws are not consistent), Design changes at this stage, Mistake in design,.

Table 8.1 Comparison of top 10 causes by both methods (RII and IMPI)

RANK	RISK EVENTS	RANK	RISK EVENTS
1	Poor or defective design due to using inappropriate design parameters	1	Conflict of laws related to one of contract clauses (laws are not consistent)
	Poor design check by consultant regarding the level of complexity and type of construction		
2	Mistake in design	2	Design changes at this stage
3	Design process doesn't include sensitivity study to assess the impact of natural hazards	3	Technical mistakes during construction stage by contractor
4	Consultant is not informed about the changes in project	4	Strike during implementation phase
	Complexity of project time management due to complex nature of the project		
5	Delay in contract issue by owner of the project	5	Allocation of risks to the parties is not mentioned or is not clear in the contract
6	Imposed unrealistic time planning for project due to insufficient or incorrect information	6	Changing of mind of bank before finalizing the contract
	Conflict of laws related to one of contract clauses (laws are not consistent)		
	Poor time Management due to change of manager or management strategies of the project		
	Mistake in design		

7	misunderstanding of drawings and specifications	7	Poor time Management due to change of manager or management strategies of the project
8	Design changes at this stage	8	Actual quantities differ from the contract quantities
9	Litigation conflict with neighbour of the project	9	Litigation conflict with neighbour of the project
10	Poor design check by consultant regarding the level of risks for project works and/or third party	10	Delay in contract issue by owner of the project
	Design process doesn't include impact assessment of the construction on third party structures and infrastructures.		

Table 8.2 Comparison between various groups of risks by both methods

RANK	CONSTRUCTION PHASES	RII	CONSTRUCTION PHASES	IMPI
1	Design Phase	0.75	Management Phase	52.96
2	Management Phase	0.73	Contract Phase	51.07
3	Contract Phase	0.70	Feasibility Phase	38.98
4	Construction Phase	0.611	Construction Phase	35.02
5	Feasibility Phase	0.606	Design Phase	30.05

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BIOGRAPHIES



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She was completed his B.E. Civil in 2016.

Author's
Photo

She was completed his B.E. Civil in 2016.