**CONTENTS**

**SL.NO. HEADINGS PAGE NO.**

1. ABSTRACT 10

2. INTRODUCTION 11

3. OBJECTIVE OF STUDY 12

4. LITERATURE REVIEW 13

* 4.1: General 13
* 4.2: Complexities & cost overrun measures 14
* 4.3: Estimation of delays in construction sectors 14
* 4.4: Cost-Performance Characteristics 14
* 4.5: Organizational culture in construction industry 15
* 4.6: Some more researches on cost overrun 15

5. METHODOLOGY 16

* 5.1: Preliminary Study 17
* 5.2: Factors of cost overruns 17
* 5.3: Design of questionnaires & contents 17
* 5.4: Determination of RII Values from responses 17
* 5.5: Graph work and analysis 18

6. CASE STUDY ON COST OVERRUNS 19

7. DATA ANALYSIS 21

* 7.1: General Characteristics of respondents 21
* 7.2: Causes of cost overrun 21
* 7.3: Test & Hypothetical analysis 25
* 7.4: Spearman’s Correlation analysis 26

8. RESEARCH METHODOLOGY 27

* 8.1: Literature Review 28
* 8.2: Selection of relevant topics 28
* 8.3: Recognizing & characterizing issues 28
* 8.4: Foundation of targets & research plan 28
* 8.5: Questionnaire design 28
* 8.6: Suggestions from experts 28
* 8.7: Finalization of questionnaires 29
* 8.8: Sampling 29
* 8.9: Data collection 29
* 8.10: Study on questionnaires on cost & time

excess 29

* 8.11: Study of responses from each category of

Respondents 30

* 8.12: Ranking of data according to correlation

& regression analysis 30

* 8.13: Researches and findings 30
* 8.14: Qualitative conclusions drawn arrived from

statistical procedures 30

9. RESULTS & DATA INTERPRETATION 31

10. CONCLUSION 39

11. INSIGHTS 41

12. FUTURE SCOPE AND DEVELOPMENTS 44

**LIST OF TABLES**

**SL.NO. LIST OF CONTENTS PAGE NO.**

1. Representation of the severity of impacts from

the responses obtained from respondents 31

2. Representation of the severity of impacts

(continued). 32

3. Representation of **RELATIVE IMPORTANCE**

**INDEX** (RII) (in %) of the impacts 32

4. Representation of separate RII values of owner,

contractor and consultant 33

5. Representation of results of **ANOVA** test 34

6. Representation of correlation between owner &

contractor 35

7. Representation of correlation between contractor &

consultant 36

8. Representation of correlation between consultant

& owner. 37

**LIST OF FIGURES**

**SL.NO. LIST OF CONTENTS PAGE NO.**

1. Figure showing step-by-step procedures under

taken in methodology 16

2. Figure showing the process of research method

ology. 27

3. Figure showing the column-bar chart with the

RII values of owner, contractor and consultant

mentioned in it. 38

**ABSTRACT**

Cost overruns in infrastructure projects around the world is common which represents significant, but avoidable, economic losses. Historical data over the last several decades indicates that cost performance has not improved over time -no significant learning has occurred. Studies have identified a wide spectrum of various causes for cost overruns in infrastructure projects. According to *Flyvbjerg et al*. (*2004*), the two main causes of cost overruns are: optimism bias and strategic misrepresentations. Other studies have found that factors such as lack of experience, the size of the project, mistakes in design, overall price fluctuations, inaccurate estimations and scope changes have impacts on cost overrun (*Memon et al*., *2011*). The myriad of causes makes the planning and management of projects difficult. The objective of this research is to propose a theoretical framework sorting the causes and corresponding management approach in the infrastructure project. The empirical literature on infrastructure project cost overrun causes is reviewed and catalogued for causes of cost overrun. Based on the review, a typology of cost overrun causes has been developed to provide a theoretical framework that organizes and describes parsimoniously the pattern of relationships between types of causes and overrun, thus simplifying the seemingly complex pattern of relationships. The typology study organizes the main causes in five types: market volatility, pressure for distorting estimation, novelty, complexity, and time pressure; and develops a conceptual framework that identifies and explains patterns of relationship between causes and overrun within each category.

Thus, the significant and the most idealistic approach is to complete the project with abiding to the laws proposed by the government, major standards and neglecting minor errors which can be simplified methods and a reliable working procedure, which would be suitable to the labourers.

**INTRODUCTION**

The construction project performance is generally expressed in terms of time and cost variance against its baseline. Out of the four fundamental constraints namely scope, cost, time and quality, cost performance is the most essential and common issue in the global construction industry. It is important to measure the cost variance in construction to understand the performance of the project and thereby to understand financial risks involved in the project execution. The cost variance, resulting as project cost overrun is denoted as a negative impact on economy and the profitability. Several perspectives on cost overrun are available in extant literature and are proven valid. However, it is not adequately explained on why the cost overrun keeps occurring though sufficient knowledge on cost overrun has been largely shared. The causes of inaccuracy in forecasts are different for different projects. The change of governance structures for forecasting the project development as an external factor also threat the project planning and execution. It was found that projects do not perform as forecasted, in terms of costs: almost 9 out of 10 projects fall victim to significant cost overrun. The underlying causes of such inaccurate cost projections were investigated and summarized.

The research is proposed to improve current construction practices of determining the construction cost and controlling the cost as the project progresses. The aim is to propose a framework for managing the risk factors involved in cost performance of non-infrastructural construction projects and thereby developing construction cost assurance. This will be achieved on proper understanding of various risk factors which are the causes of cost overrun and understanding their impact on the project execution. To obtain this, the causes of cost overrun are to be identified and classified according to the different stages and progress of the project. The task summarization and control of the project cost is not an easy task and it requires adequate knowledge on application cost-controlling techniques. Therefore, professionals working in sectors are required to have a theoretical knowledge on cost-controlling techniques.

**OBJECTIVE OF THE STUDY**

The study on cost overrun in construction projects importantly signifies the impacts and consequences of cost overrun on a project, on a whole and what losses the client or the owner has to suffer due to the cost overrun.

It is important to learn about the degree of severity or the fatal damages which can ultimately affect the construction of a project. In short, we can summarize that, this study gives a relative importance on-

* To identify the causes of delays and cost overrun in construction sectors in India by questionnaire method.
* Hypothesis test of collected data for validation
* Ranking of the causes of delay and cost overwhelm by using RII.
* Correlation between agreement and disagreement of different groups of stakeholders regarding above said causes.

**LITERATURE REVIEW**

The study narrows down the philosophical argument and some important researches on cost overrun in construction to estimate the probabilities of different strategies due to which it happens, and finding an approximate solution to the problems. Empirical profiling of cost overrun research reveals the predominance of mono-method studies based on questionnaire survey methods, correlative analysis, and archival data modeling techniques, all of which are underlain by positivism. The study argues that such positivist philosophies, although methodologically valid, cannot adequately explain and provide an in-depth understanding of the contextual drivers in construction organizations, that trigger the more tangible technical constructs, leading to the phenomena of cost growth in projects.

The reviews and importance of determining the ill-effects of cost overrun in construction industry has been a major challenge in many projects and it has been defined by the implementation of time and cost complexity occurred in a project due to the same. The common views of all sectors of people on this problem has been described as under: -

1. GENERAL: For the purpose of this study, qualitative research approach has been adopted wherein extensive review of research articles has been carried out. In UK, a study was undertaken by *Yakubu* *Adisa Olawale* (2010) founded cost overrun factor that are lack of software, Inaccurate time and cost estimate, cash flow of project, equipment breakdown, material shortage, non-performance of sub-contractors etc. Similarly, *Ismail Abdul et al.* (2013) found significant factor causing cost overrun in construction project are shortage of labour low productivity level of labours, lack of experience of contractor and subcontractor, equipment breakdown, financial difficulties by contractor, unclear and inadequate detail drawing, design change. A cost overrun is a major problem in both developed and developing countries (*Angelo* *Reina*, 2002). Hence, problem of cost overruns is a critical factor to be studied to alleviate the issue in the future. While more than seventy articles are referred to in this study, fifty-three peer-reviewed research articles on causes of delays in different countries are selected for review and analysis. This is visible and evident as two of the highly ranked causes of delays in developing countries – delay in payments from clients and contractor’s financial difficulties rank lowest in developed countries.

2. COMPLEXITY AND COST OVERRUN MEASURES: A number of studies have been conducted to estimate the time and cost complexity caused due to the cost overrun, in terms of technical complexity, amount of overlap and independencies in constructional stages, organizational complexity and unpredictable circumstances. In Saudi Arabia, (*Bubshait* and *Al-Juwairah* (2002) examined 42 main factors influencing the construction cost. They determined the severity index each of the answers and responses obtained from the local respondents, and concluded that some factors influencing cost overrun are incorrect planning, poor financial control on site, inexperience in managing contracts.

3. ESTIMATION OF DELAY IN CONSTRUCTION SECTORS: The characteristics & challenges in construction projects vary from one type of project to another type. In Vietnam, *Le*-*Hoai* *et al*. (2008) found the major significant factors influencing cost overruns such as financial difficulties of owner, errors in estimation and faulty tendering, financial difficulties of contractors, design changes. *Enshassi* *et al.* (2009) analysed the major factors causing cost overruns which includes border closures, inaccurate drawings at the construction stage, delay in continuous supply of materials and manpower etc.

4. COST-PERFORMANCE CHARACTERISTICS: The challenge in the non-infrastructural construction project is sourcing of funds, cash-flow management, and completion of project on time. The performance of project is directly related to the cash-flow of the project, which in turn looped to the payment to the contractors that affects the construction progress. The cost performance of the project highly relies on cost overrun, which is referred as an increase in the budget, cost or any growth in the cost. Similarly, In Egypt, *Remon Fayek Aziz* (2012) had overtaken a survey to observe the cost overrun in waste water projects. The survey was conducted with experts and representatives of construction firms. He identified 52 factors from the questionnaire survey. And he finally concluded that prevention of fraudulent, applying short term goals and purchasing of the bulk materials and keeping them stock are some preventive steps to overcome cost overrun.

5. ORGANIZATIONAL CULTURE IN CONSTRUCTION INDUSTRY: Researchers and professionals in different fields have recognized the role of organizational culture in the performance of organizations (*Ankrah*, 2007; *Deal*, Kennedy, 1982; *Peters*, 1982; *Kotter Heskett*, 1992). The participants of the construction industry made this subject a focus of debate as they have become aware of its significant role. Even though organizational culture is not the only factor that affects the success of a company, developing a corporate culture supersedes these factors such as corporate strategy, market presence, and technological advantage.

6. SOME MORE RESEARCHES ON COST OVERRUN: A qualitative research approach carried out by *Kasimu* *M*. *A*. (2012) concluded that concluded that the time factors are mostly responsible for cost overrun, and he also found that errors in drawing and fluctuation in materials price due to growing demand are some more factors, by ranking the causes.

*Ameh et al.* (2010) has researched on cost overrun in the tele-communication fields and suggested that the economic instability, problems regarding payment to the petty contractors and workmen, frequent changes in price of the equipment etc., are some accelerates cost overruns.

**Methodology**

The above listed elements in the flow-chart have been discussed in detail in following:

1. PRELIMINARY STUDY: First we had gone through all the concepts about the cost-overrun, its significance, the problems caused due to it, and methods to eradicate it, in order to get a clear idea of the same. Preliminary study also included collecting ideas about the cost overrun from people, magazines, booklets and various publications.

2. FACTORS OF COST-OVERRUN: The major factors responsible for the occurrence of cost overrun are determined and listed for classification along with the degree of severity.

3. DESIGN OF QUESTIONNAIRES AND CONTENTS OF QUESTIONNAIRES: The questionnaire has been designed in such a way that it considers the objective of the study with the aim to answer the research questions. Based on an extensive literature review and input from industry experts, 48 factors that causes cost overrun were listed in the questionnaire form. The major causes of cost over-runs from the literature have been listed and the respondents were asked to state the frequency of causes of cost over-run happening in their past or current projects. The reply has been noted in terms of five-point Likert scale for each of the listed causes that was organized in the form of frequency scaling (1 **= very little**, 2 = **little**, 3 = **moderate**, 4 =**high**, 5= **very high**). The questionnaire was distributed to planning managers and cost consultants of mega-sized infrastructures and builders involved in projects.

4. RELATIVE IMPORTANCE INDEX (R.I.I) (%) from responses: The responses from people were taken and by categorizing each factor (i.e., very little, little, moderate, high and very high), the R.I.I value of each response, for each impact of cost overrun was determined by the formula (**R.I.I %**) = **(∑an) / N**, where a=weighting given to each factor by the respondents and ranges from 1 for very little to 5 for extremely, n=frequency of the response obtained from all the respondents; and N=total number of respondents. Then, the R.I.I value of people choosing for owner, the people choosing for contractor, and the people choosing for the consultant, as responsible for cost overrun are scrutinized and their mutual correlation values are worked out. **Analysis of variance** (ANOVA) is an analysis tool used in statistics that splits an observed aggregate variability found inside a data set into two parts: systematic factors and random factors. The ANOVA test was carried out taking into consideration the R.I.I values so obtained in the above method, and was found to be satisfactory.

5. GRAPH WORK AND ANALYSIS: The correlation values so obtained are plotted into column bar charts, depicting impacts of cost overrun in the abscissa and R.I.I values in the ordinate. The R.I.I values of owner, contractor and consultant are shown in different colours in the graph, for a correct knowledge about their values.

**CASE STUDY ON COST OVER-RUNS**

1. The construction industry in India is considered as an important parameter for the development of the country as it creates lot of opportunities such as investments across and various other sectors. One major indicator is the intrusive pace of construction activities happening in the country. The economist and development analysts of the country believe that if the current national level strategies or initiatives are consistently supported with other initiatives in the areas of health, labour and education, agricultural sectors, engineering, and aviation fields too. However, the construction industry in India has been suffering from many complications which affects cost, quality of work, time and major factor being political situations and techniques that has been followed in the mode of construction. Poor time and cost performance are critical issues the construction industry is facing right now, and as a result construction companies fail to achieve project objectives in the stipulated time. The study is intended to find out the major causes of cost and time overrun that affect a project success.

2. *Shrestha* *et al*. (2013) carried out research on 363 public construction projects and found that the cost of the work is directly proportional to the dimensions of the work, and determined a correlation in between them. According to *Odeck* (*2004*), he concluded that the cost overrun in small sized projects is relatively lower than that in the large-sized projects.

3. *Van et al*. (*2015*) determined the relation between actual project objective and the actual cost of the budget and suggested that the timely delays in designs, hiring of unskilled workers etc. can affect the relative progress of a work. Time delay or overrun can defined as the addition of time beyond planned completion time for a construction project dates accountable to the contractor. ‘Delay’ is an event which tends to postpone the project activities and impacts the progress of the project. These includes, unavailability of resources, weather delay, design delay etc.

4. According to *Dyer* and *Jha* (2005) they distinguished the project into the success and failure phases, taking into consideration the success attributes such as intelligence, technology, etc. and failure attributes such as ignorance. The extent of delay duration depends on the type of project that has been undertaken, i.e., small time delays for small-sized works, and heavy time delays for mega-projects. Projects such as maintenance works experiences most intense time delay (*Bordat et al*. *2004*). *Kouskili* and *Kartan* (*2004*) suggested that the unsuitability of proper materials, defective plants and tools etc., are some main causes of cost overrun in projects. The studies revealed that, in spite of numerous efforts made by the technical supervisors to examine the type of work done, the cost overrun is a major problem which not only increases the overhead cost of the project, but also consumes time, hence compromising with the timely completion of the works.

5. *Larsen et. Al* (2009) had researched on 26 different factors from the managers’ perspective view. These factors directly rely on contractors and consultants and include errors in tenders, lack of proper reconnaissance survey, and other time and cost factors.

*Fidan et.al* (2011) had built a direct relationship between the risk and cost overrun. He carried out many validation tests and suggested that although many causes are still vulnerable for occurrence of cost overrun, it may vary from one project to the other in different parts of the world. The validation tests are of main importance as they provide us with a relative idea that risks variably relates with cost overrun. Though many studies have been conducted on delays in construction projects this study is unique since it gives suggestions to all the major participants in a project namely owner, contractor and client. Results shows that delay in payment to the contractor by the owner creates major impact on the project and has been ranked number one in the owner related attribute factors. Payments to contractor is regarded as first priority, to complete the construction project on perfect time.

**Data Analysis**

1. GENERAL CHARACTERISTICS OF RESPONDENTS: The analysis of the impacts started with preparation of questionnaires on a google form, by clearly mentioning the probable causes from which cost overrun may take place.

* The respondents were generally engaged in government as well as private construction projects. The respondents were basically engineers of construction firms, contractors and some consultants also.
* From studying the response sheet thoroughly, we observed that nearly 75% of the respondents suggest that cost overrun is caused due to improper cash flow, funding, late delivery of materials, working of unskilled labourers, faulty machineries, while some 15% respondents showed their interest towards suggesting that overrun occurs when the owner is not financially strong, due to land disputes, late handling of materials etc., while remaining 10% responded towards lack of technical skills, lack of proper construction strategies, improper management of events and unforeseen weather conditions, as well as financial burden to the government.
* In order to overcome the cost overrun, respondents suggested that i) before tendering all the drawings and estimates must be checked and no alteration should be made in it., ii) The project must be closely monitored and there should be a proper co-ordination in between the owner and contractor, iii) Periodic inspection is important to monitor the daily progress of work.

2. CAUSES OF COST OVERRUN: Some important causes leading to cost overrun in construction projects are listed as under: -

* Unsuitable weather conditions,
* Poor construction strategy,
* Poor site management,
* Improper cash flow,
* Increase in the cost of the project,
* Problems pertaining to environment clearance,
* Influence of local or political parties.
* If the owner is not financially viable,
* Rise in demand and price of materials,
* Frauds and miscreants,
* Errors in estimates and designs,
* Conflict in between owner and contractors or labourers,
* Changes in soil characteristics,
* Hiring of unskilled labourers,
* Failure of equipment at work site,
* Late delivery of materials and machineries,
* Late handling of materials,
* Accidents on the work site,
* Liquidated damages,
* Inadequate materials,
* Additional departmental charges etc.

Each of the above-mentioned causes are briefly explained below: -

a) Unsuitable weather conditions- Unpredictable weather circumstances, such as alternate rain, heat, cold, humidity etc. can affect the smooth going of a work, as it may not be possible for the workers to make arrangement for some shelters immediately.

b) Poor construction strategy- A poor method of construction, without a proper planning and management could lead to failure of a construction.

c) Poor site management- It is the duty of every owner/company that, before construction of a structure, the reconnaissance survey must be carried out in order to determine the nature and profile of the ground. The result of an improper site management could lead to many problems such as eroding of the underground soil, which affects the foundation layer directly, underground water have an access to the building thereby causing efflorescence etc.

d) Improper cash flow- As haphazard cash inflow and outflow during the project could lead to many overhead charges, therefore it must be ensured that with proper records and documents, the payment to the contractor or workers must be made strictly on time.

e) Increase in cost of project- This problem is not very common in Indian projects but may exist in the form of surplus expenses made by the owners on the extra materials, or tools which can alter the proposed tendering cost of the project.

f) Problems pertaining to environmental clearance- This is a very common problems in all industries and infrastructures. If the client has not taken appropriate permission from the government regarding authorization of land, then his construction can be terminated at any stage of the work.

g) Influence of local or political parties- If the area in which project is undertaken is someway controlled by the local political parties, then they can threaten the client to provide them with some shares or pieces of land.

h) If the owner is not financially viable, then he must choose some other alternatives in order to take up his construction, otherwise the construction cannot be completed on due time. He can request the government to provide him with some assistance, or he may can take loans from the nearby banks.

i) Rise in prices and demand of materials- If there is a sudden rise in the calculated cost of the tools and plants, then it will alter the overall estimated cost of the project and it this is a general reason of cost overrun. To avoid such cases, the estimation should be made on a little higher side of the expected cost, to be on the safer side.

j) Frauds and miscreants- Some miscreants could try to steal the materials during any stage of the construction and the work may get suffered. Hence the owner is expected to make sufficient arrangements to avoid such circumstances.

k) Errors in designs and estimates- Any error or alteration in the actual estimate could lead to cost overrun, as there will be a sequential variation of the price from time to time, and hence the lumpsum charges will also increase.

l) Conflicts in between owner and contractor or labourers- A good human behavior is very important to execute all works smoothly. Any casual approach or an improper communication between the involved parties could lead to failure of the project. Due to miscommunication, some labourers will not be intending to work as the demand of the client, and hence this will lead to many structural demerits.

m) Changes in soil characteristics- If the underlying soil is of an organic nature, soaking water, or is loosely packed, hence forming voids, it would lead to the structural failure of the foundation of the structure, and hence there would be cost overrun. Hence it is always recommended to study and test the general characteristics of the soil before taking up a project.

n) Hiring of unskilled labourers- If a contractor arranges a group of labour those who are not technically sound, and are inefficient, they cannot work properly as per specifications. This problem is quite uncommon in India.

o) Failure of materials at work site- Delivery of faulty equipment and machineries could lead to this problem, and this can heavily affect the daily progress of a work, hence the contractor has to arrange some new materials thus leading to cost overrun. For example, if a concrete mixer plant was working properly, but due to some technical issues it failed, then that day’s work will be stopped and the contractor has to arrange a new one in order to get the mixing of concrete done within estimated time.

p) Late delivery of materials and machineries- If the market couldn’t supply the tools and plants in the sanctioned time, then the work will get affected, hence leading to cost overrun. Therefore, before the project the supply-demand chain must be perfectly understood by the contractor.

q) Late handling of materials- Soon after the tendering process is completed, if the handling of materials is not as per the scheduled time, then it would lead to cost overrun. This is caused due to departmental errors.

r) Accidents at the work site- If any accidents is caused on the work site, due to carelessness of the labourers or due to faulty equipment, then due to non-availability of labour, the work may get affected. Also in these cases, the owner and the contractor have to suffer penalty.

s) Liquidated Damages- It is a fixed sum of money paid to the labourers for working extra hours in a day, and the cost may very from Rs.50 to Rs.100 for different categories of workmen. It leads to very minimal cost overruns.

t) Inadequate materials- If the material so supplied is not meeting with the expected numbers of tools and plants, then the contractor has to purchase new materials, which would not only cause cost overrun in purchase, but would also lead to additional transportation charges.

u) Additional departmental charges- This includes all the overhead charges that the contractor has to make for arranging food items, shelters, water, work charged establishments, additional tools and plants and other contingencies. This cost generally varies from 5% to 8% of the total estimated cost.

3. **TESTS AND HYPOTHETICAL ANALYSIS**

A: 1. H (0) There is no significant difference in severity among the identified causes causing delay in construction project due to the delay group

H (a) There is a significant difference in severity among the identified causes causing delay in construction project due to the delay group.

2. The responses obtained from the questionnaire is categorized based on their rank of severity, (i.e.; (1) for Very Little, (2) for Little, (3) for Moderate, (4) for High, and (5) for Extreme), by the application of **LIKERT’S SCALE**.

3. The data so obtained above are used for the determination of RELATIVE IMPORTANCE INDEX (R.I.I) in %.

**R.I.I.** = **(∑an)/N**

Where, a=weightage given to each response, varying from 1 for very little to 5 for extreme,

n=frequency of that response obtained from the respondents,

N=total number of responses.

4. Analysis of Variance (ANOVA) is an importance test for determining the difference between two or more means. It also shows the degree of variance. Usually, the ANOVA test is considered satisfactory up to 5% of the **P**-**Value**.(P-value gives us an idea that the data that we’ve collected is probable to be under the null hypothesis).

B. **SPEARMAN’S CORRELATION**: Spearman rank correlation is a non-parametric measure of the monotonic association between two variables. It is a rank-based version of the Pearson correlation. The correlation was determined by the R.I.I. values obtained between owner-contractor, contractor-consultant, and consultant-owner.

**RESEARCH METHODOLOGY**

The research methodology carried out is shown by the following elements in a simple flow chart: -

Literature Review

Ranking of different indices of correlation and regression analysis.

Study of responses from each category of respondents

Selection of relevant topic

Suggestions from experts (Field experts and academicians)

Finalization of questionnaires

Sampling

Questionnaire design

Foundation of targets and research plan

Recognizing and characterizing the issues

Qualitative conclusions arrived from statistical procedures

Research findings and results

Data Collection

Study of questionnaires for time and cost excess

Each element of the flow chart has been described as under-

a) Literature Review: Before the start of the project, we had gone through research and journal papers to understand the present scenario of cost overrun in construction projects and to obtain a general information about the data we need to collect for our research.

b) Selection of relevant topic: The topic so chosen is all about determining the factors influencing cost overrun in industrial projects and how they can affect the smooth execution of a work. The practical need of this study is to analyze the correlation between various impacts from the responses obtained from respondents;

c) Recognizing & characterizing issues: After obtaining adequate information from the literatures, we listed down probable causes due to which cost overrun could take place and arranged them.

d) Foundation of targets and research plan: The research we had taken up is wholly based studying the journals, written by authors, published by many institutions or are cited by some authors. We got a reliable idea how to form strategies to prepare questionnaires and with sufficient causes with their impacts listed in it.

e) Questionnaire Design: The questionnaire has been designed in such a way that it considers the objective of the study with the aim to answer the research questions. Based on an extensive literature review and input from industry experts, forty-eight factors that causes cost overrun were identified. To validate the listed factors with respect to Indian construction sector, few discussions were conducted with our project mentor mam.

f) Suggestion from Experts: We would be failing to make our research a success without the extensive help of DR. DEBA PRAKASH SATAPATHY SIR, Head of the department, Civil Engineering, and Ms. PRAMODINI SAHU mam, Assistant professor, Department of civil engineering. They have guided us and made us understood that how to collect data, ideas, extended their helping hand towards preparation of questionnaires, providing referrals for our questionnaires, etc.

g) Finalization of questionnaires: After preparation of questionnaires, the errors or any alterations to be made in it are completed. After properly going through the contents of the questionnaire, copies were printed out and were made ready to be distributed among the respondents.

h) Sampling: In this step we’ve selected the most probable impact or the impact which is most likely to cause cost overrun in construction projects, in order to determine the maximum probability of choosing that impact by the respondents. It is a type of statistical analysis.

i) Data Collection: The important factors causing cost overrun is listed down in a google form, and is sent to different officials in both government and private offices, for their responses and opinions on the concerned matter. Also, for collecting data in the remote areas, we’ve reached to the contractors and engineers to obtain their responses. The views of different sectors of people emphasized us to carry out more researches.

* Based on the all the projects, this section analyses the main reasons for cost overruns. This section is based on the results of all the projects. The interviewees were asked about the main reasons for cost overruns in the poor cost performance projects and the factors which avoided it in good performance projects. The interviewees were explained with the definition of cost overrun, according to this research so as to prevent their own perception from clouding the responses.

j) Study of questionnaires from time and cost excess: The time and cost complexities always exist in a project, and it can affect the execution of the work. Time overruns can also be defined as an act or event that extends the time to complete or perform an act under the contract. It can be also defined that time overruns as simply the time overrun either beyond the completion date specified in a contract or beyond the date that the parties agreed upon for delivery of a project.

* Cost complexity refers to the overhead charges that the contractor has to make for the arrangement of commodities other than the actual estimated cost of the project. This cost varies from 10% to 12% of the actual estimated cost, and includes the expenses for broken machineries, work-charged establishment charges, etc.

k) Study of responses from each category of respondents: By going through 49 responses obtained from the respondents (mainly engineers, contractors and consultants) involved in different private and public sector undertakings. Most of the respondents believed that the cost overrun takes place due to insufficient time of project, inaccurate designs and estimates, poor land and finance management, unskilled labourers, bad working conditions, rise of cost of process etc.

l) Ranking of data according to correlation and regression analysis: The responses so obtained are arrange in a proper manner, and then we determined the Relative Importance Index (R.I.I.) value after ranking the critical factors responsible for cost overrun. The Analysis of Variance (**ANOVA**) test was also conducted to determine the variance between the RII values of different impacts. Then, we determined the rank of each impact and then obtained the spearman’s correlation value.

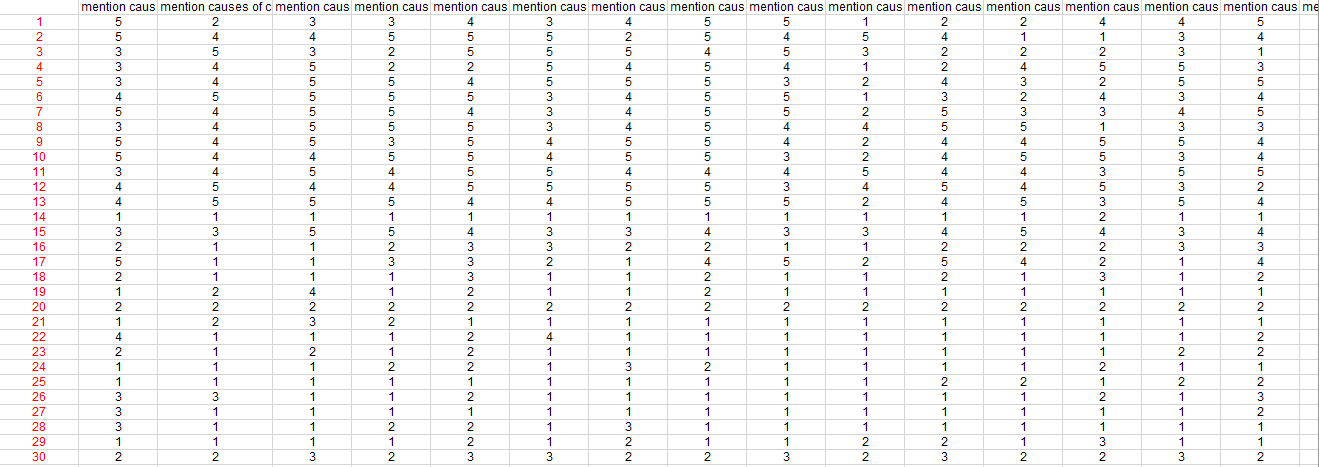
m) Researches and findings: The findings from this survey were to determine the factor which has the most, and the factor which has the least effect in occurrence of cost overrun, by suitably ranking those factors. It was determined that, the impact largely responsible for cost overrun is conflict in between the owner and contractor and the least responsible is unsuitable weather conditions and pandemics.

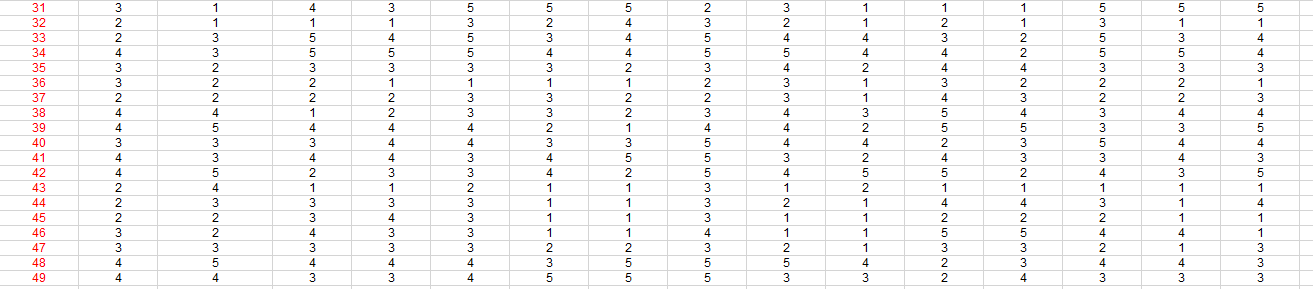
n) Qualitative conclusions arrived from statistical procedures: From this research we’ve drawn both qualitative and quantitative conclusions. The qualitative conclusions consist of determination of the type of factors responsible for cost overrun and their weightage in occurrence of cost overrun. While the quantitative conclusions consist of determining the relative severity of each impact by ranking them and determining the correlation in between them.

**RESULTS AND DATA INTERPRETATION**

The survey started by identifying the respondents’ backgrounds such as their experiences in terms of years and the number of projects in which they have been involved. It helped to ensure that the data collected were reliable. The research was mainly focused on finding out the degree of understanding that the contractors had on cost control methods.

* STEP-1: Based on the respondents’ 49 responses, we first categorized the impacts into their level of severity for causing the cost overrun. (i.e., 1 for Very Little, 2 for Little, 3 for Moderate, 4 for high and 5 for extreme). The Excel sheet representation for the same is being shown below-





* STEP-2: After categorizing each of the response to their respective severity values, the Relative Importance Index of each impact was determined by the formula-

**Relative Importance Index (RII) =(∑an)/N**, where a=weighting given to each factor by the respondents and ranges from 1 for very little to 5 for extremely, n=frequency of the response obtained from all the respondents; and N=total number of respondents. The Excel Sheet representation for the same is being shown below-







* STEP-3: Then we segregated the response of the respondents into 1st part (consisting of the responses choosing ‘owner’ is responsible for cost overrun), 2nd part (consisting of the responses choosing ‘contractor’ is responsible for cost overrun), and 3rd part (consisting of the responses choosing ‘consultant’ responsible for cost overrun), and determined their R.I.I Values. The graph for the same is shown sequentially as under;



* STEP-4: The next step involves testing of the R.I.I value by determining the degree of variation between them by ANOVA (Analysis of Variance) test. The test was simple and it represents the Maximum probable value (P-value), F-Value which shown the variation between sample means relative to the variation within the samples, and Critical value of P. The Excel sheet representation for the same is being shown below-



* STEP-5: Next, we go for determining the Spearman’s Correlation by degerming the Rank of owner, contractor and consultant. The correlation values are determined by choosing sets of R.I.I value of- i) owner and contractor, ii) contractor and consultant, iii) consultant and owner, and the values are depicted. The Excel sheet representation for the same is shown as under-







* STEP-6: Finally, we plotted the data so obtained above in column bar charts and observed the weightage of each impact in occurrence of cost overrun. The Excel sheet representation for the same is shown below-

**CONCLUSION**

* This study has been focused on assessing cost overrun problems and their causative factors in the non-infrastructural Indian construction projects. The structured questionnaire was used to acquire information on the relative importance of cost overrun factors. A descriptive statistical analysis was carried out and the following findings were discovered.
* Cost overrun is a major issue in project performance and agreed by 90% of the respondents. The cost baseline is been fixed at different stages of project for various projects and is been revised many times in the project. The most significant cause of cost overrun includes scope creep, construction delays, rework and practice of awarding the contract to the lowest bidder.
* The changes in design and specifications, changes in scope, additional works, design errors, incomplete design, delay in design delivery reflects in delayed construction, excess contractual claims, disputes at site and poor project management price fluctuations, inflation, increase in wages and material prices could be related to the contractual clauses to avoid cost overrun during execution of the project, poor coordination at site, poor communication are the internal factors that reflects the delay in construction and contractual disputes.
* Proper procurement strategy to be executed for awarding the contracts/consultants/suppliers as the result shown as the practice of boarding lowest bidder reflect cost overrun and extra claims at the project closure; delayed construction contributes poor project performance in terms of cost also. It results in poor scheduling of project, complexity of constructions not considered in scheduling of the project. Hence appropriate risk analysis tool and scheduling methods to be used to mitigate. The internal factors such as Scope creep design/specification changes Poor selection of contractors’ ineffective procurement planning and can be mitigated through proper training to the planning team / managers.
* The external factors such as changes of laws and regulatory framework political complexities, unforeseen site conditions, rework construction delays Ineffective planning & monitoring, delay in decision making contractual disputes, Inflation / price fluctuations, delay in regulatory approvals can be mitigated through appropriate risk analysis technique before project inception.
* Better cost control is essential for reducing the profit margin. Compensation of the increase in the material and labor cost is the next reason for the increase in the profit margin. Based on their experience, most of the contractors believe that they can reduce about half of their overhead cost by using proper cost controlling techniques. Some contractors have already achieved more than half overhead reduction through cost controlling techniques. Thus, a proper cost controlling can be considered as an essential component in the construction industry.
* Thus, finally we can conclude that, some important strategies must be prepared or ordered so that the work can go without any hindrances, such as in case of rainy season, suitable arrangements for tents, huts or small dwelling houses should be made, so that in case of any emergency the workers can reside there. Land acquisition is another one reflective element in overcoming of the cost overrun. The client or the company should plan to construct on an authorized land so that in future, no problems related to land disputes can take place. Furthermore, the working conditions must be safe and secure, so as to mitigate the undesired chances of accidents to workers or so.

**INSIGHTS**

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**FUTURE SCOPE AND DEVELOPMENT**

The study wholly considers factors inﬂuencing the cost overrun of the entire construction investment. The idea of the collection of responses from respondents and, in turn, the analysis of individual works included in the investment. The previous practice and experience show that the factors selected for the cost analysis have the greatest direct impact on the cost change of individual investment elements. At the same time, they take into account a number of factors that, according to the literature, aﬀect the cost overrun of the entire investment. The numerous scientiﬁc and research works presented so far focus mainly on factors inﬂuencing cost overruns and predicting such overruns, taking into account the conditions of the whole particular investment. The results obtained here are usually rather approximate. More accurate data can be obtained by analyzing individual stages (elements) of the investment. Each of them has its technological, organizational, and economic speciﬁcity.

Therefore, considering them independently may facilitate the analysis of factors inﬂuencing the incurred costs and allow for greater precision in determining the risk of cost overruns. One of the factors inﬂuencing the increase of planned costs, when considering individual elements, is the share of a given element in the total cost of a facility. The higher the share, the potential changes in costs, even to a small extent, may signiﬁcantly aﬀect the overrun cost of a facility. Another factor taken into account is the risk of changes in the number of works. It is a factor that involves both the stage of investment preparation, including the manner and quality of the prepared design documentation, but also the speciﬁcity of a given type of works. For example, earthworks, even with properly prepared design documentation, are characterized by a higher risk of changing the scope and quantity of works than, for instance, construction works. Thus, a good coordination at work place, proper flow of materials and money and correct designs are some preventive steps to overcome cost overrun.