"ANALYSIS OF DELAY FACTORS IN BHUJ REGION"

Rasik Bhuva[1], Dr. Jishnu Goel[2]

[1]Student of Master of Engineering, Ahmedabad, Department of Civil Engineering
[2]Indus Institute of technology and Engineering, Ahmedabad, Gujarat, India

---

ABSTRACT: *Construction delays are one of the biggest issues that are being in the construction industry and affecting delivery in terms of time, budget, and the required quality. The features of delay factors and their effects varies from project to project, and can last anywhere from a few days to years. Delays have large impacts on construction projects; therefore, it isvital to investigate the causes of delay and analyze their impact.*

The main of this thesis is to quantify the topmost delay factors in the Bhuj region using the Important Index (100%) method. The Likert scale was used in this survey:1-Completely disagree 2-Disagree 3-Agree 4- Completely Agree.

A questionnaire survey was conducted in the Bhuj region. The survey was conducted among owners, consultants, and contractors. A total of 35 respondents were selected. Out of that 22 responses were received. A total of 8 contractors, 11 consultants, and 3 owners responded to the survey.

The questions used in the survey were to determine the frequency of occurrence of factors and the impact of factors in the project. These factors were divided into eight groups respectively-materials, manpower, equipment, project management,owner, consultant, early planning and design, and external factors.

The top five factors that have been found which are responsible for delayare-
Shortage of required equipment, Shortage of required equipment, Shortage of required equipment, Shortage of required equipment, Delays in sub-contractor'swork.

Keywords: Delays, risk matrix, delay analysis, construction, types, causes of delay

1. INTRODUCTION

This thesis deals with construction delays in the Bhuj construction industry. Construction delay is a foremost problem facing the construction industry in almost all countries in the world. Delays exist in nearly any building project, and their lengthsrangegreatly from one to the other, varying from a few days to several years. Construction delays are widely recognized as the most significant influencing factor. the delivery of construction projects in terms of time, budget, and the required quality. However, it is very important to identify the exact causes and their significance to minimize and avoid the impact of delays in construction projects. It has been found that construction projects completed on time were a signal of project efficiency; however, construction processes depend on several unpredictable factors that occur from various sources. These sources include the performance of construction stakeholders, availability of resources, site conditions, contract types, weather conditions, and the contractual relations between stakeholders. However, it is uncommon for a project to be finished on schedule and underbudget.

This research paper focuses on developing the methodology for analyzing and quantifying the impact of delay. It explores research by highlighting the main issues associated with construction delays and providing recommendations to reduce the impact ofdelays.

2. LITERATURE REVIEW

Aibinu and Jagboro (2002) studied the effects of delays in project delivery in the Nigerian construction industry and investigated how the effects of delays on project delivery and the totalconstruction cost of building projects can be minimized. and investigated how the effects of delays on project delivery and the total construction cost of building projects can be minimized. Aibinu and Jagboro concluded that the delay could lead to both costs overrun, and time overrun. The loss and expense claims arising from delay, and fluctuation claims due to project delay, had a significant effect on cost overrun.

Zaneldin (2006) investigated construction claims in the United Arab Emirates. The research looked at the types, causes, and frequency of construction claims in the Emirates of Dubai and Abu Dhabi using data collected from 124 claims related to different projects. The data were analyzed to identify problem areas and to recommend how to reduce claims in future

constructionprojects.

Koushki et al. (2005) conducted a study in Kuwait to study the causes of time overrun in construction projects. A person-interview survey of 450 randomly selected private residential project owners and developers has been done. They concluded that the main causes of delays are changing orders, owners' financial constraints, and owners' lack of experience. Mezher et al. (1998) surveyed the causes of delays in the construction industry in Lebanon from the viewpoint of owners, contractors, and architectural/ engineering firms. It was found that owners had more concerns about financial issues; contractors regarded contractual relationships the most important,whileconsultants considered project management issues to be the most important causes of delays.

Assaf and Al-Hejji (2006) discussed the delay in`large construction project in Saudi Arabia. A total of 73 causes of delay were identified during the research. They concluded that the most common cause of delay identified by the contractors, the consultant and the owner are "change order".

3. TYPES AND CAUSES OF DELAYS

From the literature review, 75 causes of delays categorized into 8 different groups were found to make a questionnaire survey with respective participants i.e., Owners, consultants, and contractors.

3.1 Causes of Delay

Consultant associated factors

- Absence of knowledge of consultant in construction
- Late in performing inspection andtesting
- Late in revising and approving design papers

Contractor associated factors

- Changing of subcontractors again and again
- Lack of skill of the contractor
- Rework due to errors Design associated factors

Equipment associated factors

- Shortage ofequipment
- Frequent equipmentbreakdowns
- Low efficiency of theequipment

External associated factors

- Accidents during construction
- Price fluctuations
- Problem withneighbors
- Unfavorable weather condition

Labor associated factors

- Shortage of workers
- Own clashes among labor
- Strike
- Unqualified/inadequate experienced labor

Material associatedfactors

- Modifications in material varieties and specifications duringconstruction
- Destruction of arrangedmaterials
- Late delivery of materials

Owner associated factors

- Clashes between partners
- Late in progressoutflows
- Late in site supply

3.2 Effect of Delays

1. Time Overrun and CostOverrun
2. Reduction in profit for the owner due to costoverrun
3. Dispute, Arbitration, or Litigation b/w participants of theproject
4. Abandonment ofproject
5. Difficult in improving the market value of the contractor'scompany

4. METHODOLOGY

The study area of this project is delay analysis. Literature was collected and studied. Based on knowledge gained by literature, the project is carried out.

The no. of factors that cause delays were identified and a questionnaire survey was formed based on this. The questionnaire sample was divided into three parts - Part one was related to general information of the respondent's experience and associated company. Part two is related to the respondent's experience of project performance. Part three included the list of seventy-five delay factors, identified from the earlier literature review. These factors were further classified into four categories and eight sub-categories according to the sources of delay. Data analysis was done by the IMPI method and recommendations are given based on this survey. The risk matrix is formed to understand the impact of thedelays.

5. DATA COLLECTION

The procedure used in analyzing the results was aimed at establishing the frequency of factors and their impact on the project. The Importance Index was computed using the following equation-

$$IW = [F.I.(\%) * S.I.(\%)]\ /100$$

$$(F.I.)(\%) = \sum_{a=1}^{4} a(n/N) * 100/4.$$

$$(S.I.)(\%) = \sum_{a=1}^{4} a(n/N) * 100/4.$$

For Frequency Index (FI)-

For a response of never,a=1

For a response of occasionally, a=2

For a response of frequently, a=3

For a response of constantly, a=4

For Severity Index (SI)-

For a response no effect,a=1

For a response of fairly severe, a=2

For a response of severe,a=3

For a response of very severe, a=4

Table 1- Percent of questionnaire distribution and their response

Description	Questionnaire distributed	Number of Responders	Percentage ofresponse
Owners	7	3	61.5
Contractors	13	8	73.33
Consultants	15	11	42.85
Total	35	22	62.85

Table 2-Respondents by type of working organization

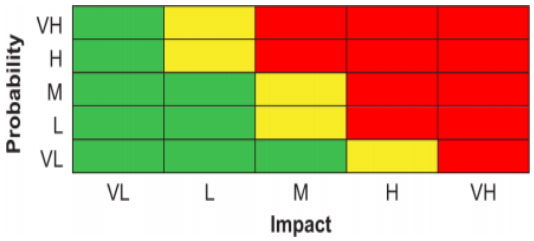
Public	Private	Both	Total
2	13	7	22

5.1 Risk Matrix

The standard risk matrix, which is used to determine the risk zone for each identified factor. The matrix is 5*5 with impact ranging from VL to VH on the horizontal axis and probability (with the same range) on the vertical axis. Three zones are presented in the matrix (The US Federal Highway Administration Office of InternationalPrograms,2007) :(1) green; (2) yellow; and (3) red. The zones are distinguished by the following characteristics: green zone: threats are minimal in this zone and can be overlooked. The threats in the yellow zone are of mild importance; if they occur, one should deal with them and goon. However, if their likelihood of occurrence is moderate, they should be minimized, and if their effect is moderate, they should be minimized. it should be controlled and reduced, and a contingency plan should be in place just in case they do. The threats in the red zone are very severe. These are the top priorities and are risks that close attention should be paid tothem.

Figure 1- Risk Matrix

	VL	L	M	H	VH
VL	Green	Green	Green	Yellow	Red
L	Green	Green	Yellow	Red	Red
M	Green	Green	Yellow	Red	Red
H	Green	Yellow	Red	Red	Red
VH	Green	Yellow	Red	Red	Red



6. DATA ANALYSIS

Data are analyzed using MS Excel and Statistical Package for Social Sciences (SPSSs). The mean and standard deviation were used to express numerical results.

The data was collected in form of a questionnaire survey. A total of 35 questionnaires were distributed and 22 responses were returned. The respondents included contractors, owners, and consultants. The frequency and severity index were calculated for every delay factor to find the topmost delay factor. The importance Index was calculated using frequency and severity index. The risk matrix was calculated for the delays based on the case study. The zone was determined according to the risk of delay- Green zone for low level, Yellow zone for moderate importance, and Red zone for critical importance.

Based on the ranking, the top ten delays are-

Table 3- Top ten delay causes ranked according to Frequency Index.

Delay group	Cause	F. I
Material related	3. Changes in materials prices	79.54
Management-related	31. Delays in sub-contractor's work	78.40
Owner related	49. Delay in progress payments by the owner	76.13
Manpower related	9. Shortage of manpower (skilled, semi-skilled, unskilled labor)	73.86
Management related	11. Lack of motivation among contractor's members	73.86
Management related	26. Inefficient quality control by the contractor	73.86
Management related	34. Poor site management and supervision by contractor	73.86
Owner related	40. Lack of coordination with contractors	73.86
Owner related	43. Delay in furnishing and delivering the site to the contractor by the owner	73.86
Planning related	60. Changes in the scope of the project	73.86

Table 5- Top ten delay causes ranked according to Severity Index.

Delay group	Cause	S. I
Management related	15. Contractor's poor coordination with the parties involved in the project	77.27
Material related	3. Changes in materials prices	76.13
Manpower related	10. Low skill of manpower	76.13
Management related	23. Ineffective planning and scheduling of the project by the contractor	76.13
External related	65. Rise in the prices of materials	76.13
Manpower related	9. Shortage of manpower (skilled, semi-skilled, unskilled labor)	73.86
Management related	31. Delays in sub-contractor's work	73.86
Owner related	49. Delay in progress payments by the owner	73.86
External related	74. Problem with neighbors	73.86
Management-related	14. Poor communications by the contractor with the parties involved in the project	72.72

Table 6- Top ten delay causes ranked according to Importance Index.

Delay group	Cause	Imp. I
Material related	3. Changes in materials prices	60.56
Management related	31. Delays in sub-contractor's work	57.91
Owner related	49. Delay in progress payments by the owner	56.23
Management related	15. Contractor's poor coordination with the parties involved in the project	56.19
Management related	29. Difficulties in financing project by contractor	55.37
Manpower related	9. Shortage of manpower (skilled, semi-skilled, unskilled labor)	54.55
Management related	14. Poor communications by the contractor with the parties involved in the project	52.06
Material related	1. Shortage of required materials	52.06
Management related	34. Poor site management and supervision by contractor	52.04
Consultant related	50. Poor qualification of consultant engineer's staff assigned to the project	51.23

Table 6- Mean And S.D of Frequency Index.

Delay group	Cause	Mean	S. D
Material related	3. Changes in materials prices	3.18181	3.22130
Management-related	31. Delays in sub-contractor's work	3.13636	2.83972
Owner related	49. Delay in progress payments by the owner	3.04545	2.73974
Manpower related	9. Shortage of manpower (skilled, semi-skilled, unskilled labor)	2.95454	2.63597
Management related	11. Lack of motivation among contractor's members	2.95454	2.22448
Management related	26. Inefficient quality control by the contractor	2.95454	3.01408
Management related	34. Poor site management and supervision by contractor	2.95454	2.82733
Owner related	40. Lack of coordination with contractors	2.95454	2.81120
Owner related	43. Delay in furnishing and delivering the site to the contractor by the owner	2.95454	2.82733
Planning related	60. Changes in the scope of the project	2.95454	2.99137

Table 7- Mean And S.D of Severity Index.

Delay group	Cause	Mean	S. D
Management related	15. Contractor's poor coordination with the parties involved in the project	3.09090	2.94859
Material related	3. Changes in materials prices	3.04545	2.90876
Manpower related	10. Low skill of manpower	3.04545	2.54179
Management related	23. Ineffective planning and scheduling of the project by the contractor	3.04545	2.54199
External related	65. Rise in the prices of materials	3.04545	2.55962
Manpower related	9. Shortage of manpower (skilled, semi-skilled, unskilled labor)	2.95454	2.77862
Management related	31. Delays in sub-contractor's work	2.95454	2.81120
Owner related	49. Delay in progress payments by the owner	2.95454	2.82731
External related	74. Unstable laws and regulation	2.95454	2.82733
Management-related	14.Poor communications by the contractor with the parties involved in the project	2.90909	2.92711

7. CASE STUDY

A housing society has been constructed in the Bhuj region which has 270 houses. These were the following observations during the review of the project-

- Cement, steel, concrete, and metamorphic rocks were key construction materials.
- From the factory, cement and steel were imported.
- Most of the manpower (skilled and unskilled) were mixed people i.e., local peoples as well as labor from Maharashtra, MP, UP.
- Daily wage workers were brought from the local market to carry out some daily work as loading, unloading of materials, and cleaning work.

The delays which were identified in the project were-

- Changes in materials prices
- Financial problems (delayed payments, and economic problems)
- Delay in progress payments by the owner
- Severe weather conditions on the job site
- Rises in the prices of materials
- Delays in sub-contractor's work
- Delay in the preparation of drawings
- Poor design and delays in design
- Absence of consultant's site staff
- Lack of coordination with contract

Table 8- Risk Matrix for Delayed Factor

Factors	Impact	Probability	Matrix zone
Changes in materials prices	M	L	Yellow
Financial problems (delayed payments, and economic problems)	H	L	Red
Delay in progress payments by the owner	H	M	Red
Severe weather conditions on the job site	M	L	Yellow
Rises in the prices of materials	M	M	Yellow

Delays in sub-contractor's work	H		H	Red
Delay in the preparation of drawings	H		M	Red
Poor design and delays in design	M	L		Yellow
Absence of consultant's site staff	M	L		Yellow
Lack of coordination with contractors	M		M	Yellow

8. CONCLUSIONS AND RECOMMENDATIONS

The topmost delay factors according to FI are- Changes in materials prices, Delays in sub- contractor's work, Delay in progress payments by the owner, Shortage of manpower (skilled, semi-skilled, unskilled labor), Lack of motivation among contractor's members.

The topmost delay factors according to S.I are- Contractor' spoor coordination with the parties involved in the project, Changes in materials prices, Low skill of manpower, Ineffective planning and scheduling of the project by the contractor, Rise in prices of materials

The topmost delay factors according to IMPI are- Changes in materials prices, Delays in sub- contractor's work, Delay in progress payments by the owner, Contractor's poor coordination with the parties involved in the project, Difficulties in financing project by contractor

These are the following recommendations that might help in reducing delay in a construction project-

For Owners-

- Hiring an expert contractor in fieldwork who has a good reputation.
- Making sure tender documents are complete and clear.
- Choosing a good consultant who has enough experience.
- They must pay progress payments as fast as possible.
- He should fast as possible in decision

For Contractors-

- Choosing experienced subcontractors with a good reputation.
- Development of proper cashflow.
- Proper site management and supervision for effective planning and scheduling of the project.
- To do a proper inspection of the site and appropriate testing of materials.
- Motivate to improve workers' skills by awarding pay rises.
- Avoid reworks at the site, since they reduce the morale of foremen and workers
- Contractors should plan effectively for the delivery of materials and equipment in time to avoid expected delays from late delivery during construction.

For Consultants-

- They should not make errors during early planning.
- They should not be late in producing the design as it will create schedule delays in the project.
- Clearly understand the requirements of owners before starting work.

The general recommendation for all parties-

- The roles and responsibilities of each party should be identified.
- All parties should preview the site and suggest necessary amendments before the issue of notice to proceed.
- Proper communication and coordination channels between the parties at each stage of construction.
- To avoid time extensions due to adverse weather, it is recommended to improve site making to not hinder work.
- Minimum order changes during construction to avoid delays.
- Check for the resources of the contractors before awarding the contract.

REFERENCES

- Leena Mali, Abhijit Warudkar (2016), "Analysis on causes of Delay in Construction Industry in Pune City" International Journal of Innovative Research in Science, Engineering and Technology, ISSN(Online): 2319-8753, ISSN(Print): 2347-6710
- Nuhu Braimah(2013), "Construction Delay Analysis Techniques- A Review of Application Issues and Improvement Needs" Journal of Civil Engineering and Architect,506-531
- Dinesh Kumar R(2016), "Causes and Effects of Delays in Indian Construction Projects" International Research Journal of Engineering and Technology, e-ISSN: 2395-0056, p- ISSN: 2395-0072
- Wa'el, A, Azizah, S, and Mohd, R. (2007), "Housing shortage for low- income in Yemen: causes and suggestions", Engineering, Construction, and Architectural Management, Volume 14 No 2007pp.192-206
- Lewis, J. (2002), Fundamentals of Project Management (2nd ed.), American Management Association, ISBN0-8144-7132-3
- William Ibbs, Long D Nguyen(2007), "Schedule Analysis under the effect of Resource Allocation" Journal of Construction Engineering and Management,ASCE,131-138