



Feasibility Study on Delay Factors Influencing Construction Projects in India

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ABSTRACT

A construction project is said to be fruitful only when the project gets executed within estimated time, budget and attains the desired strength. Thereby time delay is a frequent phenomenon and is almost associated with nearly all construction projects. The major aim of the study is to find out the most possible delay factors which affect the completion of a construction project within scheduled time. The study also includes a questionnaire survey from various respondents which includes about 41 delay factors and the respondents includes contractors and consultants in the Southern region of India. The result obtained by the questionnaire from the respondent are analyzed for identifying the delay causes using Relative Importance Index (RII). Findings reveals that that the main cause for delays are shortage of labor, difficulties in financing project by contractor, late procurement of materials and unclear and inadequate details in drawings ranked highest among the major factors causing delay in construction projects in Southern Regions of India. The study concludes that there still exist a number of causes of delays and their effects put construction projects at great risk that have an effect on their performance. It is therefore recommended that change orders by owner during construction and late in revising and approving design documents by owner will also affects the project completion on time. Not all the delays can be rectified, but few of them can be neglected by improving management responsibilities. The recommendations and limitations are also discussed in the conclusion part of study.

Keywords-- Causes of delay, construction industry, delay factors, relative importance index

major role in ascertaining the future of a country therefore the delays should be avoided or neglected in practice. But there are various hurdles from different aspects which enhances the delays in the construction industry. Based on different perceptions and responsibilities among different groups the construction delay and their effects vary, therefore the delays based on different groups should have to be analysed. Concerning the construction delay it not only affects the present project it also affects the companies profile, delay in the start of the future project and also leads to cost overrun due to the hike in material costs. Along these lines, time delays lead to increment in capital-yield-ratio for whole economy. Basically, postpones can decrease the productivity of accessible assets and limit the construction capability of whole economy. Therefore, the inadequacy of research on the subject is surprising [2].

Scope of the Study

The opportunity of this study is restricted to the construction projects especially in Southern region of India. The information obtained in this study has been gathered through detailed previous studies and questionnaire survey. Causes of delay in construction industry can be gathered through precise monitoring the planned schedule of the construction project. Mostly delays can be managed but cannot be neglected.

- The study helps to identify the delay factors in construction industry
- To find the key delay factors and to find out by ranking the delay that can majorly affects the project

Objectives of the Study

- To find out the major causes of delay in construction projects through a questionnaire survey.
- Based on the different perceptions among the group the delay factor for each group should be identifies
- To suggest general methods and techniques in order to minimize the different delays affecting the projects.

I. INTRODUCTION

Due to inherent risks and increasing complexity of modern projects, delays and cost- overruns have become common facts in the industry. Researchers and practitioners have used many techniques to assess project delays and apportion delay responsibility among the parties involved [1]. Since construction industry plays a

II. LITERATURE REVIEW

Ali Tarhini, Muhamad Fakhri studied the construction project in the Lebanon faces delay in their execution. While project manager fails in monitoring the progress of the projects. The problems were distinguished as technical and non- technical problems. Their study includes 131 causes of delay which are identified in the research and findings the results reveal finance and payments of completed work is the major delay factor that affects the construction work [3].

Delays and Disruptions:

Geraldine John Kikwasi took over the construction projects in Tanzania which discloses that the construction projects are at higher risk affects by means of several delay factors. Using the relative importance index the top delay factors that he obtained are design changes, delays in payment to contractors, information delays, funding problems and poor project management. Then the effects due to the construction delay based on the respondent rankings are time overrun, cost overrun, negative social impact, idling resources and disputes. Therefore the recommendations that they gave are adequate construction budget, timely issuing of information, and rapid finalization of design [4].

Drewin Open Conversion System (DOCS) have been used by Norngainy Mohd Tawil for analyzing the delay factors in the Malaysian context. DOCS are a system that reflects the input and output of a construction activity. Using Winstep, a Rasch analysis software the results are predicted the most factor that causes delay to the construction industry according to his study are mistakes during construction, unrealistic project durations and bad weather conditions [5].

Delay which generally caused in the construction projects in Baghdad city has been studied by Quai Kadhim Jahanger. The questionnaire was setup with that of 58 causes of delay and the data was analyzed for various respondents. The result thus concluded was unqualified workforce, low productivity of labours, difficulties of skilled workforce to work in different sites because of security conditions, shortage of labours and personal conflicts among labours. And they analyzed among the various respondents using spearman's correlation coefficient [6].

Thereby having a global economy in a construction industry we have to avoid and manage the construction delays. Kasimu Alhaji Mohammed and Abubakar Danladi Isah researched in the construction industry in Nigeria. The data thus obtained in analyzed by means of finding the Mean value and Standard deviation the resultant output was improper planning, lack of effective communication, design errors, shortage of materials and slow decision making [7].

Relating the causes and effects of delay in same criteria was essential. M. Haseeb and Xinhai- Lu said both

the causes and effects of delay are interconnected. According to their study in the construction projects of Pakistan they conclude that the labour and material related causes are accompanying with the effects of time overrun and cost overrun. Then the labour and finance related causes are associated with the effects of disputes, negotiations and court cases [12].

III. METHODOLOGY

From the above study now we may have some ideas to frame a questionnaire and also we have cross checked by means of analyzing the questionnaire setup to the expertise person. By means of approaching a construction firm and analyzing the projects movement of nature we can decide the possible delay factors. After the confirmation of the questionnaire respondents were asked to fill the questionnaire based on the importance factor. Direct field analysis should be used for taking the response from the respondents (contractors, clients and consultants)

Questionnaire Design

A questionnaire was setup by means of literature review [1] and expert's suggestion. A questionnaire was set which was divided into two parts, the first part includes the respondent's profile and in the second part mentions about the causes of delay. In our study questionnaire includes about 41 most possible delay factors which have been shortlisted from the previous study by means of expertise suggestion. The questionnaire was distributed to the construction industry which the interview was taken on site and on worksite office. Their scheduled time for the completion of the each project is noted down and thereby analyzing the progress of the project. The respondents include contractors, clients and consultants. The 41 causes of delay were grouped based on their characteristic [10] [13] then they are also analyzed to find out which group causes more delay in the construction projects. The groups that we listed in the questionnaire were

- Project
- Owner
- Contractor
- Design
- Materials
- Equipment
- Labour
- External Factors

The respondents were asked to mark the causes of the delay based on the frequency and severity. A five scale importance index (Likert's Scale) was used to analyze the setup which implies 5 as very important, 4 as important, 3 as somewhat important, 2 as less important and 1 as not important

Relative Importance Index

The gathered data through the questionnaire survey of the 41 causes of delay were analyzed using

Relative Importance Index (RII) [8]. The objective of this study is to find out the delay factor which affects the construction projects to complete within the scheduled time. Using RII we can calculate the response of various respondents based on the questionnaire distributed which will give the ranking of all the causes of delay. Equation (1) implies the formula used for finding out the relative importance index [9] [11] was

$$RII = \frac{\sum W}{A * N} \quad (1)$$

group will leads to most possible delay in the construction projects.

A total of 134 questionnaires were distributed directly and among that 117 were collected with a response rate of 87.31%

Where W is the weighting given to each factor by the respondents (ranging from 1 to 5), A is the highest weight (i.e. 5 in this case), and N is the total number of respondents. The RII value had a range from 0 to 1 (0 not inclusive), higher the value of RII, more important was the cause or effect of delays.

Based on the RII the causes of delay the ranking among three groups (contractors, clients and consultants) can be calculated and also overall top delay factor among three groups can be measured. Concerning the 8 group we separated based on the questionnaire we can predict which

Survey Results

Based on the respondent's response the relative important index and ranking of the delay factors was calculated and it was tabulated in the Table 1.

Table 1: Ranking and Relative Importance Index of all Delay Factors in terms of Consultant's, Contractor's and Client's perspective

Causes of Delay	Contractors Response		Consultants Response		Clients Response		Group
	RII	Rank	RII	Rank	RII	Rank	
Original Contract Duration is too short	0.6417	21	0.6551	16	0.6857	7	Project
Legal Disputes between various parties	0.6328	23	0.6827	12	0.7047	5	Project
Delay to furnish and deliver the site to the contractor by the owner	0.6119	26	0.6620	15	0.6476	12	Owner
Change orders by owner during construction	0.7492	7	0.7724	2	0.6380	13	Owner
Late in revising and approving design documents by owner	0.7223	12	0.7517	4	0.7333	2	Owner
Slowness in decision making process by owner	0.6179	25	0.6206	18	0.5809	19	Owner
Suspension of work by owner	0.6507	19	0.7172	8	0.6666	10	Owner
Rework due to error by contractor	0.7253	11	0.6758	13	0.6190	15	Contractor
Improper understanding of the project scope	0.5313	35	0.5379	27	0.6	17	Contractor
Poor site management and supervision by the contractor	0.6447	20	0.6620	15	0.6666	10	Contractor
Inadequate contractors work	0.6537	18	0.6068	20	0.6476	12	Contractor
Difficulties in financing project by contractor	0.8	2	0.7241	7	0.7142	4	Contractor
Conflicts between contractor and other parties	0.5820	29	0.6482	17	0.6666	10	Contractor
Poor communication and coordination by contractor with other parties(consultant and owner)	0.6656	17	0.6620	15	0.7333	2	Contractor
Improper construction methods implemented by contractor	0.5641	33	0.6	21	0.6666	10	Contractor
Delays in producing design documents	0.6955	13	0.6620	15	0.5809	19	Design
Unclear and inadequate details in drawings	0.7373	8	0.7586	3	0.7428	1	Design
Mistakes and discrepancies in design documents	0.6805	16	0.7310	6	0.7142	4	Design
Misunderstanding of owner's requirements by design engineer	0.6388	22	0.7034	10	0.6571	11	Design
Insufficient data collection and survey before design	0.5671	32	0.6	21	0.5809	19	Design

Supplied material was defective	0.6865	15	0.6689	14	0.6095	16	Materials
Delay in material delivery	0.7522	6	0.7448	5	0.6719	9	Materials
Changes in material types and specifications during construction	0.6925	14	0.6896	11	0.6666	10	Materials
Late procurement of materials	0.7910	3	0.6896	11	0.6952	6	Materials
Equipment breakdowns	0.6	27	0.6206	18	0.6095	16	Equipment
Shortage of equipment	0.6298	24	0.6551	16	0.6476	12	Equipment
Low level of equipment- operator's skill	0.5432	34	0.5655	24	0.6	17	Equipment
Low productivity and efficiency of materials	0.5313	35	0.5724	23	0.6571	11	Equipment
Shortage of labours	0.8238	1	0.8344	1	0.7047	5	Labour
Unqualified workforce	0.6	27	0.6	21	0.6285	14	Labour
Low productivity of labours	0.6417	21	0.7172	8	0.6761	8	Labour
Personal conflicts among labours	0.5731	31	0.5582	26	0.5428	21	Labour
Regular absenteeism of labours	0.7283	10	0.7103	9	0.5333	22	Labour
Changes in government regulations and laws	0.5880	28	0.6068	20	0.7238	3	External Factors
Delay in obtaining permits from municipality	0.7701	4	0.6896	11	0.6	17	External Factors
Effects of subsurface conditions (soil. High water table)	0.7343	9	0.7034	10	0.5904	18	External Factors
Natural causes (floods, earthquakes)	0.5761	30	0.5931	22	0.5238	23	External Factors
Unavailability of utilities in site	0.7671	5	0.6896	11	0.6190	15	External Factors
Rain effect on construction activities	0.7283	10	0.6758	13	0.5428	21	External Factors
Accident during construction	0.4626	36	0.5586	25	0.5428	21	External Factors
Delay in performing final inspection and certification by a third party	0.5880	28	0.6137	19	0.5619	20	External Factors

Overall Relative Importance Index and Ranking

By means of using all the 117 respondents the ranking and the relative importance index for each factor

was calculated and listed in the Table 2. Table 2 denotes the top rated delay factors which affects the construction projects.

Table 2: Overall Ranking and Relative Importance Index

Causes of Delay	RII	Ranking
Shortage of Labours	0.8068	1
Difficulties in financing project by the contractor	0.7641	2
Late procurement of materials	0.7453	3
Unclear and inadequate details in drawings	0.7436	4
Change Orders by owner during construction	0.7368	5
Delay in material delivery	0.7316	6
Late in revising and approving design documents by owner	0.7282	7
Unavailability of utilities in site (water, electricity)	0.7265	8
Delay in obtaining permits from municipality	0.7265	8
Effects of subsurface conditions (soil, high water table)	0.706	9
Mistakes and discrepancies in design documents	0.6974	10
Rework due to error by contractor	0.6923	11
Changes in material types and specifications during construction	0.6889	12
Regular absenteeism of labours	0.6889	12
Rain effect on construction activities	0.6872	13
Poor communication and coordination by contractor with other parties (consultant and owner)	0.6786	14

Suspension of work by owner	0.6684	15
Delays in producing design documents	0.6667	16
Supplied material was defective	0.6667	16
Low productivity of labours	0.6632	17
Legal Disputes between various Parties	0.6598	18
Original Contract Duration is too Short	0.6581	19
Misunderstanding of owner's requirements by designer engineer	0.6564	20
Poor site management and supervision by contractor	0.6513	21
Inadequate contractors work	0.6376	22
Shortage of Equipment	0.6376	22
Delay to furnish and deliver the site to the contractor by the owner	0.6291	23
Changes in government regulations and laws	0.6154	24
Slowness in decision making process by owner	0.6137	25
Conflicts between contractor and other parties	0.612	26
Equipment Breakdowns	0.6085	27
Unqualified workforce	0.6	28
Improper construction methods implemented by contractor	0.5949	29
Delay in performing final inspection and certification by a third party	0.588	30
Natural causes (floods, earthquakes)	0.5778	31
Insufficient data collection and survey before design	0.5761	32
Low Productivity and efficiency of materials	0.5607	33
Personal conflicts among labours	0.5607	33
Low level of equipment- operator's skill	0.5538	34
Improper understanding of the project scope	0.5419	35
Accident during construction	0.5009	36

As of the questionnaire was distinguished into 8 groups (Project, owner, Contractor, Design, Materials, Equipment, Labour and External factors). Based on the questionnaire response the group which causes more delay to the project should have to be predicted. So, using relative importance index the ranking of the group that we assigned was predicted. Table 3 describes the ranking among the group and their respective relative importance index.

Group	RII	Ranking
Materials	0.7081	1
Owner	0.6752	2
Design	0.6680	3
Labour	0.6639	4
Project	0.6589	5
Contractor	0.6465	6
External Factors	0.6410	7
Equipment	0.5901	8

Discussions of Results

As per the survey results obtained by means of questionnaire survey the top 5 ranked delay factor was mentioned as follows

- Shortage of Labours
- Difficulties in financing project by the contractor
- Late procurement of materials
- Unclear and inadequate details in drawings

- Change Orders by owner during construction
Concerning the three groups Contractor, Consultant and clients the top ranked among the respondents were tabulated below

Table 4: Top 5 Ranked Delay Factors based on Contractor's Response

Delay Factors	RII	Rank
Shortage of Labour	0.8238	1
Difficulties in financing project by the contractor	0.8	2
Late Procurement of Materials	0.7910	3
Delay in obtaining permits from municipality	0.7701	4
Unavailability of Utilities in site	0.7671	5

Table 5: Top 5 Ranked Delay Factors based on Consultant's Response

Delay Factors	RII	Rank
Shortage of Labour	0.8344	1
Change orders by owner during construction	0.7724	2
Unclear and inadequate details in drawings	0.7586	3
Late in revising and approving design documents by owner	0.7517	4
Delay in material delivery	0.7448	5

Table 6: Top 6 Delay Factors based on Client's Response

Delay Factors	RHI	Rank
Unclear and inadequate details in drawings	0.7428	1
Late in revising and approving design documents by owner	0.7333	2
Poor communication and coordination by contractor with other parties	0.7333	2
Regular absenteeism of labours	0.7238	3
Difficulties in financing project by the contractor	0.7142	4
Mistakes and discrepancies in design documents	0.7142	4

Finally, we predicted the top ranked delay factor for overall respondents. Now, the top ranked delay factor on each group was mentioned as follows. Table 7 shows the top ranked delay factors in each group.

Table 7: Top ranked Delay factor in each group

Delay Factors	Group	RHI
Legal Disputes between various parties	Project	0.6598
Change orders by owner during construction	Owner	0.7367
Difficulties in financing project by contractor	Contractor	0.7641
Unclear and inadequate details in drawings	Design	0.7435
Late procurement of materials	Materials	0.7452
Shortage of Equipment	Equipment	0.6376
Shortage of labours	Labour	0.8068
Unavailability of utilities in site	External Factors	0.7264

IV. CONCLUSION

Delays occur in every construction project and the magnitude of these delays varies considerably from project to project. Some projects are only a few days behind the schedule; some are delayed over a year. So it is essential to define the actual causes of delay in order to minimize and avoid the delays in construction project.

There are five objectives of this study which have been achieved.

- Identifying the delay factors in construction projects.
- To analyse the delay factors using SPSS and to demonstrate the ranking of factors and categorize according to their mean values on delays.
- To determine which group will cause more delay in construction industry.

- Categorize mean value and rank delay factors based on each respondents like contractors, consultants and clients

- Make recommendations in order to control delays in construction projects.

Construction delay in construction industry is explained through literature review and field survey. Through in-depth literature review and by experts suggestion 41 causes of delay were identified, about 117 construction firms including contractors, consultants and clients responded the questionnaire forms. The most important factors that contributed to the causes of delay are shortage of labours, difficulties in financing project by the contractor, late procurement of materials, unclear and inadequate details in drawings, change orders by owner during construction

V. RECOMMENDATIONS

Based on the findings during analysis, following points can be recommended in order to minimize and control delays in construction projects.

For Shortage of labour- owner or contractor should take care of that they should have sufficient labours with them to complete the work well before. In case of shortage of labours, for small works they can use the small equipment to replace some manpower so that instead of doing work manually machine can do the work faster. Qualified staff with appropriate experience must be appointed to follow technical and managerial aspects of the project. The staff will be more effective if there are enough numbers of engineers, planning managers, technicians and foreman so the responsibilities would be shared between all of them.

For Rework due to errors and changes in project- it can be avoided from the initial stages of the project, if planning is accurate there is no need of rework to be done. Errors also can be avoided if details in drawings are given accurately. At the time of submission of drawings, architects and engineers should give all the necessary details without any omissions. Drawings should be very much clear and easy to understand so that at the time of actual execution of work one will not face any difficulty and wastage of time and project will complete in time as per originally planned.

For performing inspection and certification by a third party- the certifier should be a trust worthy person and an experienced candidate so that they can complete their inspection on time which does not affect the project by delay. The certifier should be observed by means of the management or owner so he/she may work and completes their task on time.

For Accident during construction- A safety officer should be appointed to the firm so that he/she may implement all the safety rules to be followed on site. And also all the workers should be educated about the benefits

of the safety. Safety meetings should be conducted regularly and personal protective equipment's should be used by all the workers without fail.

For inaccurate site management- in case of inaccurate site execution rework and corrections has to be done and it will take additional time. Hence contractor or site supervisor should not do any mistakes when actual work has been started. As the project management is important part, well experienced project manager should be appointed on site so that he/she will manage all the activities on site. There is a need for contractor in improving abilities of managers, engineers which is a vast demand in successful completion of projects. Thus, the contractors have to adapt from essential innovative management techniques, including organizing, controlling, team building and value engineering that may be more efficient and effective. Having applied these techniques, it would guarantee to reduce the risks of such critical factors.

For delay in obtaining permits from authorities- the owner should do accurate time planning such as he/she should do all the necessary formalities well before the commencement for that he/she should approach to architect, engineer for planning and designing so that all the necessary documents and drawings can be submitted to the authorities in time and they will not affect the project delivery time..

For mistakes and delays in producing design documents- in case of unrealistic and complicated drawings given by architects it may difficult for RCC designer to fit that design technically, in that case changes are suggested by the RCC designer that will cause delay and rework must be done. For this faster completion of work must be done by different parties. Proper and timely communication must be done to avoid delay.

For poor communication and coordination- since there are many parties involved in a project such as client, consultant, contractor, sub-contractors, communication and coordination with other parties is a very crucial factor to achieve the project to finish on time. Effective communication can alleviate most of the delay factors. Proper communication and coordination channels between the various parties should be establish during each phase of construction. For this weekly or monthly meetings should be conducted. Any problem with communication may result in severe misunderstanding and therefore, delays in execution of the project.

For subsurface condition- Construction projects necessarily involve the assessment of site surface (and subsurface) conditions to select the best means and methods to develop a construction schedule and bid and to complete the project. In some cases, contractors are encouraged to perform additional investigations, as needed to become better acquainted with the field conditions. Bidding contractors may be provided with a stipend to conduct additional subsurface investigations.

For Financing- contractors should manage his/her financial resources in order to not face money problems and plan a cash flow by utilizing progress payments. Pay progress payments to the contractor on time because it impairs the contractor ability to finance the work and also motivate him/her to continue working in high rate.

For legal disputes between various parties- the documenting procedures between those should be precise so that no misunderstanding will occur that prevents from legal disputes. In order to solve a dispute, if occurs, a third party arbitrator should be appointed by a governing body approved by all the parties. Thus the delays by means of legal disputes can be minimized.

For improper construction methods- the method executed by the contractor for the construction projects should be a practiced and well versed technique by the contractor itself. The designers, engineers, supervisors and labours appointed by the authority should have gained adequate knowledge and experience in the adopted method of construction.

For material defect- the procured material for the construction project must be defect less and also to satisfy all the standards that are essential for the project. The contractor must check and approve the quality of each material acquired.

For delay in material delivery- the contractor should assure that the supplier has delivered the materials on time. The supplier should also be a trust worthy enough to supply the materials on the time required by the contractor.

For late procurement of materials- the contractor should plan early for procuring of materials before the clearance of safety stock in site. The stock level of the materials should be periodically noted so that there are no possibilities of lack of materials.

For Equipment breakdown- the contractor should be aware of the condition of the available equipment's at the site, whether the equipment was able to perform the required operations at the site. And also he/she should monitor the performance of the equipment and also have a brief knowledge about the wear and tear of the equipment's. In order to avoid the equipment breakdown or such situations he/she should provide periodical service/maintenance for the equipment, whenever it is necessary.

For shortage of equipment- the contractor should maintain a log about the necessity of equipment's to be used at the project. The schedule for requirement of equipment to be used should be planned earlier to the project.

For low productivity of labours and unqualified workforce- the contractor should ensure himself/herself that the labours appointed to perform a certain job were qualified enough. If the contractor encounters the lack of

knowledge on a labour, he/she should be trained enough to perform the job defect less.

For unavailability of utilities in site- the authorities must ensure that the availability of utilities such as water, electricity in the construction site. If not so the authorized personnel should make an arrangement for the continuous availability of water and electricity prior to the commencement of work in the construction site.

For personal conflicts among labours- the site personnel should aware of the labours that there are no conflicts among them. If such unexpected problems arrive, the authority should counsel the respective labours and also monitor them for avoiding such incidents. If such conditions repeat again the labours should be expelled or charges should be imposed on them.

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