International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 07 | July 2018 www.irjet.net p-ISSN: 2395-0072

DELAY ANALYSIS AND ITS EFFECTS IN CONSTRUCTION INDUSTRY

Ram B. Tosniwal[1], Prof. Shashank U. Vanakudari[2]

[1]M.TECH Student, Department of Civil Engineering, Jain College of Engg & Tech, Karnataka, India.
[2]Assistant Professor, Department of Civil Engineering, Jain college of Engg & Tech, Karnataka, India.

Abstract - Construction industry is a one of the most important sector in the development of the country and it's GDP. The delay in the execution of the infrastructure project is a global problem and recently this has hit the most of the ongoing projects all over the country. The purpose of this study is to identify the delays, factors that cause the delays and their effects on the project phase. Earlier paper considers the both causes as well as effects separately while in this paper we will carry out the process through which we will get to know the impact of both the factors on each other. As a methodology, 38 questions have been designed by considering the suggestions from the some of the consultants, clients and contractors and framed. This questionnaire is then forwarded to each of the parties to collect their responses and the survey is carried out. The replies from the individual is analysed using Relative Importance Index for each of the category of the person.

***Key Words*: Delay Causes, Effects of Delay, Preparation of Questionnaire, Analysis of Causes.**

1. INTRODUCTION

Construction delay is recognised as the most common difficulty which is effecting the time and cost of the project, leading the project in the negative aspect. Therefore, it is very much needed to rectify the causes for delay in construction process, so that it helps in minimizing the delay and consequent loses. The delay in construction can affect the period of completion of project, loss in the work productivity, acceleration of sources, increases in cost and at last may end up with project termination. The time plays as soul importance for client, contractor and the employer. Hence, it must have reason to fulfil the right decision with the prospective time in line with the cost compensation state.

Commonly the delay conditions will occur in complex state of the project. A delay occurring one by one continuously may lead to simultaneous loss of the finance of the project due to late completion of the targeted work. For the owner, delay in project execution is directly affected to the profit gains due to the minimum of production units and additional rentable things the owner needs to pay.

1.1 Definition:

"Construction delays are considered as time lag in completion of activities from its specified time as per contract or can be defined as late start or late completion of project activities to the set baseline schedule, which directly affects the project specified cost". It can also be defined as the over run of the time period beyond the due date of project completion. Delay in construction is jumping over the planned schedule which can be seen normally in all kind of construction processes. The delay may or may not affect the activity's completion time and it may or may not affect another party concerned to the activity.

1.2 Objectives of the Study

- To analyse and predict the failure of the construction project using the causes and impacts of the delays in the project.
- To study the differences in the understanding of the problems between the three major parties related to the project i.e. consultants, contractors and clients.
- To study and understand the effects of delay on the project arising during the execution phase and the factors which affects the most.
- To understand and frame the methods and steps to minimize the delay and their effects in the projects.

1.3 Literature Review

Ayman H. Al-Momani explored the reasons of the delay on public projects in Jordon to provide the solution to the construction managers in organising the solutions regarding delays using quantitative data. Projects included in this study are residential, commercial, administrative and educational buildings. The findings of the paper suggest that, a special attention has to be identified for the resolution of the problems occurred just to minimize the risk of delay.

Sadi A. Assaf and Sadiq Al-Hejji have conducted the survey on the performance of various kinds of projects in Saudi Arabia to know the causes of delays and their importance to the participants. They have identified 73 causes of delays during his research of which it was found that 76% of which is held responsible by the contractor, 56% by the consultants and 38% by the Client. They have calculated the importance index of each cause by the product of both frequency and severity of indices of each cause and also concluded that spearman's rank co-relation co-efficient is a relatively good between two parties.

Murali Sambasivan purposes his study to identify the delay factors and their effects on the project completion in Malaysia. He have considered both the causes and effects of the delay in an integrated approach and attempted to analyse the impact of both simultaneously. He has conducted the questionnaire survey to collect feedback on the causes and effects of the delay from clients, contractors and consultants. He has also derived an correlation between each cause and its effects. He has categorized the entire questionnaire based on the category of the questionnaire i.e., client related, contractor related, consultant related, material related and labour related.

Divya. R and S. Ramya have studied the major causes for construction delay, their effects and procedures to minimize the delays in the construction project, which helps in deriving the proper methods to carry out the projects in getting minimum chances of delay. They have divided the questionnaire into four sections where section A is related to general information regarding project, Section B related to the causes of delays, Section C related to the effects of delays and Sections D related to the means to minimize the delays.

Hamzah Abdul Rahman, Chen Wang, Roshana Takim and Szemin Wong have addressed the issues regarding financial related delays in construction. They have mainly aimed to know the important causes for financial related difficulties which lead to the delay in construction and simultaneously the best possible solutions to resolve the problems related to the financial aspect of the work carried out.

Ibn-Homaid N. T. and Tijani I. A. have described the role of the financial management in determining the economic status of the construction company in Saudi Arabia, it also gives an idea regarding the failure prediction of the company based on the historic data available with the company. It is also clearly shown that the construction project can be able to prevent the failure by using the result from the research.

2. METHODOLOGY

The current study is carried out from the earlier studies which are carried in the field of delay analysis and their causes and impacts on the project. In the later works the authors have mentioned the many of the causes and their effect extents in the project execution and hence, this study includes the importance of causes and their impacts on the project meanwhile on the necessary actions during the execution that can be taken so that the delay impacts can be minimized or totally made zero.

2.1 Approach:

The study is carried by following the below steps,

- Literature Review
- Identification of the variables for the study
- Preparation of the questionnaire
- Identification of parties involved
- Survey and data collection
- Analysis of collected data
- Results and discussions

2.2 DESIGN OF QUESTIONNAIRE

All the parties involved in the survey gathering are handed over with the questionnaire by using the Google forms, through the mails. This form contains the general information of the parties like the type of organizations: clients, contractors and consultants, their name / organization / firm details and the age group to which they belong to. Accordingly the next questions are based on the causes of the delays, the respondents are asked to indicate the importance level of the cause for each of the questions. These questions are mainly categorized into the groups,

2.2.1 Client Related Factors:

Delay due to the finance and payments of completed works by client/owner, Delay in deliver of the site to the contractor by the client to start the work, Delay due to the change of orders by the clients during the execution phase. Delay due to slow proceedings of client/owner for any of the decisions and Delay due to poor communication and coordination by the owner with the other parties involved.

2.2.2 Contractor Related Factors:

Delay due to financial instability and management of the contractor, Delay due to the improper planning and scheduling of the project, Delay due to the conflicts between contractors and other parties involved, Delay due to improper construction methods and poor site management by the contractors, Delay due to the poor qualification of the contractor's technical staff and Delay due to the disputes between the main contractors and sub contractors.

2.2.3 Consultants Related Factors:

Delay in performing inspection and testing by the consultants, late in reviewing and approval of the design documents by consultants and Delay due to inadequate experience of the consultants.

2.2.4 Materials Related factors:

Delay due to shortage in the construction materials during the execution phase, Delay due to changes in the construction materials types during construction, Due to the late procurement of the materials on the site and Delay due to the inferior quality of material production.

2.2.5 Equipment Related factors:

Delay in the project due to equipment breakdown, Delay in the project due to Shortage of equipments and Delay in the project due to the less efficiency of the equipment used.

2.2.6 Labour related factors:

Delay in the project due to the shortage of labour, Delay in the project due to the inefficiency of labours and Delay in the project due to the poor skill of the labours.

2.2.7 External Factors:

Delay in obtaining permits from concerned government authorities, Delay due to the weather effects on the construction activities, Delay due to the price escalation of the materials, Delay due to the traffic control and restriction of job site and Delay due to the change in orders which are not included in contract.

These questions are followed by the effects of the delay on the projects due to the above reasons are asked which were : Time overrun, Cost overrun, Disputes, conflicts, Litigations and Total abandonment. Apart from the above, the parties are requested to highlight the valuable Recommendations / Suggestions in order to minimize the construction delays through an open ended question.

A five point scale is used by the collection of the data for the questionnaire which is then transformed to relative importance indices (RII).

$$RII = \frac{\sum W}{(AXN)}$$

Where W is respondent's reply for each of the factors, A is highest reply of the same factor and N is Numbers of respondents. RII ranges from 0 to 1, smaller the value of RII lesser important factor it will be and higher the valve of RII more important factor it will be. This Collected RIIs will be used for the analysis of the respondent's replies.

3. CALCULATION AND ANALYSIS

The questionnaire which is designed by collecting the suggestions of the expertise is distributed to the all parties which involve 10 consultants, 40 contractors and 20 Clients using the web based application "Google Forms". Off all the above involved personals, total of 38 have replied to whole questionnaire in which 5 are clients (Government bodies and developers), 14 are contractors, 10 are consultants, 2 are clients as well as contractors and 7 are consultants and contractors. Off all the received replies from the respondents, the collected data can be divided based on the respondent's profession. Each individual cause's RII is perceived by the respondents is computed for overall analysis,

3.1 SUMMARY OF RESULTS

The data collected by the survey and the analysis of the same can be summarized by Table 1

The calculation of the RII clearly describes the causes and the effects of the delay on the projects according to the survey carried out. All the causes and the effects are assigned ranks based on the value of RII. From the ranking, we can able to understand most important factors which cause the delays and effect the most on the project.

Based on the ranking, from the Table no -1, the most important factor causing the delay are, (1) Improper planning and scheduling of the project with an RII of 0.895; (2) Permissions from concerned government authorities with an RII of 0.811; (3) Improper construction methods and poor site management with an RII of 0.805; (4) Shortage in the construction materials with an RII of 0.805; (5) Late procurement of the materials on the site with an RII of 0.805. Here we can observe the RII of Improper construction methods and poor site management, Shortage in the construction materials & late procurement of the materials on the site do possess the same RII of 0.805 that means all the above causes are similarly important for the cause of the delay.

According to Table No - 2, the five important cause of delay as perceived by contractors are, (1) Improper planning and scheduling of the project with an RII of 0.848, (2) Permissions from concerned government authorities with an RII of 0.829, (3) Shortage in the construction materials with an RII of 0.819, (4) Finance and payments of completed works with an RII of 0.819 and (5) Slow proceedings of client/owner for any of the decisions with an RII of 0.790.

From the above we can observe the problems faced by the contractors are due to the planning and scheduling of the necessary actions which may be due to the inefficient data received by the contractors and change in the plan of action according to the ground conditions, where as major of the other causes clearly indicate the inefficiency of clients and consultants for the execution of the works.

According to Table no 3, the five important cause of delay as perceived by clients are, (1) Improper planning and scheduling of the project with an RII of 0.943, (2) Inefficiency of labours with an RII of 0.857, (3) Late procurement of the materials on the site with an RII of 0.857, (4) Slow proceedings of client/owner for any of the decisions with an RII of 0.829 and (5) Financial instability and management of the contractor with an RII of 0.800.

From the above we can observe the problems faced by the clients are due to the improper planning and scheduling of the contractors, where as major of the other causes clearly indicate the inefficiency of contractors regarding the finance, labour and materials procurement.

According to Table no 4, the five important cause of delay as perceived by consultants are, (1) Improper planning and scheduling of the project with an RII of 0.960, (2) Improper construction methods and poor site management with an RII of 0.840, (3) Shortage of labour with an RII of 0.840, (4) Delay in deliver of the site to the contractor with an RII of 0.820 and (5) Inefficiency of labours with an RII of 0.820.

From the above we can observe the problems faced by the consultants are due to the improper planning and scheduling of the contractors, where as major of the other causes clearly indicate the inefficiency of labours regarding the works and clearance of the site from the client's part.

From the summarized Table No. -5, we can observe the major effects of the delays on the project. Accordingly the perceived data indicates the (1) Cost overrun with an RII of 0.811 is an major effect of the delay while; (2) Time overrun with RII of 0.789; (3) Conflicts/Disputes with RII of 0.637; (4) Litigation with RII of 0.637 and (5) Total abandonment of the project with RII of 0.616.

Since increase in the execution of the project increases the basic cost of the project and the increase in the basic cost of the project leads to the increased time in the execution of project. Here we can say that time and cost are directly proportional to each other, and hence delay in any of the above causes results in the loss of the other factor also.

Table – 1 : Details of RII and Ranks of Causes by All Respondents

Causes of delays	Percentage of Respondents					RII	Rank
	1	2	3	4	5		
Client Related Factors							
Finance and payments of completed works	2.6	7.9	23.7	31.6	34.2	0.774	9
Delay in deliver of the site to the contractor	2.6	15.8	18.4	39.5	23.7	0.732	14
Change of orders by the clients during the execution phase	5.3	7.9	34.2	34.2	18.4	0.705	17
Slow proceedings of client/owner for any of the decisions	0.0	13.2	23.7	34.2	28.9	0.758	12
Poor communication and coordination	5.3	7.9	31.6	31.6	23.7	0.721	15
Contractor Related Factors							
Financial instability and management of the contractor	5.3	5.3	15.8	39.5	34.2	0.784	8
Improper planning and scheduling of the project	0.0	5.3	5.3	26.3	63.2	0.895	1
Conflicts between contractors and other parties	2.6	10.5	42.1	31.6	13.2	0.684	19
Improper construction methods and poor site management	0.0	5.3	18.4	44.7	31.6	0.805	3
Poor qualification of the technical staff	0.0	10.5	36.8	26.3	26.3	0.737	13
Disputes between the main contractors and sub contractors	2.6	13.2	39.5	34.2	10.5	0.674	21
Consultant Related Factors							
Performing inspection and testing by the consultants	0.0	21.1	34.2	34.2	10.5	0.668	23
Late in reviewing and approval of the design documents	0.0	5.3	31.6	39.5	23.7	0.763	11
Inadequate experience of the consultants	0.0	21.1	21.1	34.2	23.7	0.721	15
Material Related Factors							
Shortage in the construction materials	0.0	7.9	18.4	36.8	36.8	0.805	4
Changes in the construction materials types	2.6	13.2	39.5	31.6	13.2	0.679	20
Late procurement of the materials on the site	0.0	5.3	15.8	50.0	28.9	0.805	5
Inferior quality of material production	2.6	5.3	44.7	31.6	15.8	0.705	17
Equipment Related Factors							
Equipment breakdowns	2.6	23.7	42.1	23.7	7.9	0.621	27
Shortage of equipments	2.6	10.5	47.4	26.3	13.2	0.674	21
Less efficiency of the equipment	2.6	18.4	36.8	31.6	10.5	0.658	24

Labour Related Factors							
Shortage of labour	0.0	5.3	21.1	42.1	31.6	0.800	6
Inefficiency of labours	0.0	2.6	21.1	52.6	23.7	0.795	7
Poor skill of the labours	0.0	5.3	26.3	47.4	21.1	0.768	10
External Factors							
Permissions from concerned government authorities	0.0	13.2	10.5	34.2	42.1	0.811	2
Climatic conditions	10.5	15.8	44.7	23.7	5.3	0.595	28
Price escalation of the materials	5.3	15.8	42.1	26.3	10.5	0.642	25
Traffic control and restriction of job site	10.5	34.2	34.2	18.4	2.6	0.537	29
Change in orders which are not included in contract	2.6	23.7	36.8	31.6	5.3	0.626	26

Table 2 Details of RII and Ranks of Causes by All Contractor Respondents

Rank	RII	Percentage					Causes of delay according to Contractors
		5	4	3	2	1	
1	0.848	47.6	38.1	4.8	9.5	0.0	Improper planning and scheduling of the project
2	0.829	38.1	42.9	14.3	4.8	0.0	Permissions from concerned government authorities
3	0.819	42.9	28.6	23.8	4.8	0.0	Shortage in the construction materials
4	0.819	33.3	42.9	23.8	0.0	0.0	Finance and payments of completed works
5	0.790	33.3	38.1	19.0	9.5	0.0	Slow proceedings of client/owner for any of the decisions

Table 3 Details of RII and Ranks of Causes by All Client Respondents

Rank	RII	Percentage					Causes of delay according to Clients
		5	4	3	2	1	
1	0.943	85.7	0.0	14.3	0.0	0.0	Improper planning and scheduling of the project
2	0.857	42.9	42.9	14.3	0.0	0.0	Inefficiency of labours
3	0.857	42.9	42.9	14.3	0.0	0.0	Late procurement of the materials on the site
4	0.829	42.9	28.6	28.6	0.0	0.0	Slow proceedings of client/owner for any of the decisions
5	0.800	28.6	57.1	0.0	14.3	0.0	Financial instability and management of the contractor

Table 4 Details of RII and Ranks of Causes by All Consultants Respondents

Rank	RII	Percentage					Causes of delay according to Consultants
		5	4	3	2	1	
1	0.960	80.0	20.0	0.0	0.0	0.0	Improper planning and scheduling of the project
2	0.840	50.0	30.0	10.0	10.0	0.0	Improper construction methods and poor site management
3	0.840	40.0	40.0	20.0	0.0	0.0	Shortage of labour
4	0.820	40.0	40.0	10.0	10.0	0.0	Delay in deliver of the site to the contractor
5	0.820	20.0	70.0	10.0	0.0	0.0	Inefficiency of labours

Table 5 Details of RII and Ranks of Effects by All Respondents

Effects of delays	Percentage of Respondents					RII	Rank
	1	2	3	4	5		
Effects of delays : Time Overrun	2.63	7.89	18.42	34.21	36.84	0.789	2
Effects of delays : Cost Overrun	0	10.53	15.79	31.58	42.11	0.811	1
Effects of delays : Conflicts/Disputes	2.63	21.05	42.11	23.68	10.53	0.637	3
Effects of delays : Litigation	10.53	18.42	28.95	26.32	15.79	0.637	4
Effects of delays : Total abandonment	13.16	13.16	34.21	31.58	7.89	0.616	5

From the above discussions, the ten most important factors causing the delays in the execution of the project are,

1. **Improper Planning and Scheduling of the Project (RII = 0.895)**

Planning and scheduling is a most important phase of the any project. Planning a project in a well executable and real time execution works on the ground is an first and most important aspect of any of the project. In this survey we can observe that all the categorised personals have opted improper planning and scheduling as an important factor for the causing the delays in the execution of the project. The work program of the project is widely used to complete the project within the stipulated time and cost without any delays.

2. **Permissions from concerned government authorities (RII = 0.811)**

In execution of any of the infrastructure project, all the parties involved in the project needs to take clearances from various authorities belonging to the specific departments. In India, all the government authorities are under working under different sectors and follow the specific set of rules of the same department. To clear all the issues regarding any of the department, the party has to go through all the set of rules and necessary documents. Delay in the government officials is a major issue in the delay.

3. **Improper construction methods and poor site management (RII = 0.805)**

Contractors in general to complete the works within the time carry out improper construction methods and doesn't maintains the site as per specific leads to the misleads on the site. Any work carried out without any supervision of the consultants or any of the engineers which is carried out without any experience will be weak and lead to the dismantle in some of the cases. The workmanship and the materials used during the execution plays a very important role in the project especially if it is concerned to the local contractors.

4. **Shortage in the construction materials (RII = 0.805)**

Some of the basic materials in the construction works generally face a shortage like sand, aggregates, cement, etc. This might take place due to less supply and high requirement of the materials, depletion of source of the materials, strikes and land issues during the extract, political pressures, etc. Another aspect of the shortage of materials is due to the variations in the rates of the construction materials on the daily basis, which will lead the project manager to delay the purchase of the specific materials till the rates get less of those specific materials.

5. **Late procurement of the materials on the site (RII = 0.805)**

Delay in the procurement of the materials on the site takes place in a large scale in an infrastructure sector. Since the materials are required on the site is of most important and other works cannot be executed in the absence of the same. Construction is an set of activities which need to follows up sequentially without any breakage if chain, hence the construction will get delayed in the absence of specific materials.

6. **Shortage of labour (RII = 0.800)**

Due to industrialization in all the sectors, skilled as well as unskilled labours are having a shortfall in all the sectors. Since, construction of any structure is not cyclic process executable by any of the robots or machineries. Every individual work does need a different workmanship and hence the labour weather it may be skilled or unskilled are most often required.

7. **Inefficiency of labours (RII = 0.795)**

Efficiency of the labour hired for the specific work is very less, the work quality followed by the labours are not good as per the requirement. The productivity of the labour plays a major role on the execution of the project; the works executed by the set of labours in the construction industry various on the wages. And hence, it is a tedious job to hire accurate number of labours to complete the specific work. Because if the higher number of labours are hired for completion of specific works, cost of the works increases whicl the lesser the labour is, the work might get pending to be executed.

8. **Financial instability and management of the contractor (RII=0.784)**

The finance and management of the contractor needs to be very strong to execute the work. Finance includes the investment of the contractor in any of the project, bills to be prepared on, site expenses, and additional expenses as well. Financial soundness of the contractor is most widely required in the project and the contractor should not be dependent on the any of the single source of the investment, since infrastructure line is a very wide and he should have suitable financer while management of the contractor should also need to be strong. The management should take regular meetings and review the works going on. Necessary steps and active participation from all the management is most utterly required for the execution of any project.

9. **Finance and payments of completed works (RII = 0.774)**

Construction sector requires high potential of finance, and contractors need to arrange them various sources of the finances. The executed works bills should be cleared off as

soon as possible so that contractor can manage is cash flow. Any delay in the payments and finance of the contractor leads to the delay in the execution of the works.

10. Poor Skills of the labour (RII = 0.768)

Labours in the construction industry should possess good skills for the execution of the works, the skills of the specific labours in the area where he is suitable for. For an example, labours expert in the excavation should not be used for the construction of brick works, this will lead to the improper management of the labour, inefficiency of labour, loss of skills and waste of money as well as time.

4. CONCLUSIONS

The study of Causes and effects of delays mainly included the analysis of delays in the construction projects for its improvements and change in the plan of action in day today's works so that it should not affect the project by the cost overrun and time overrun. The objective was to make the Construction project Manager more understandable regarding the causes, impacts and steps to minimize the impacts of delays on the overall completion of the construction project.

Over the study we have gone through the basics of the causes of the delays and their effects. The questionnaire was designed to get the data from the well experienced engineers working in many of the companies and tried to understand the main reason for the delays in the execution of the projects. From the entire distributed questionnaire we have found the following data along with their RII to know which factor affects the most. Improper Planning and Scheduling of the Project, Permissions from concerned government authorities, Improper construction methods and poor site management, Shortage in the construction materials, Late procurement of the materials on the site, Shortage of labour, Inefficiency of labours, Financial instability and management of the contractor, Finance and payments of completed works and Poor Skills of the labour.

The results of this study gives the practitioners weather they may be client, contractor or a consultants a basic knowledge regarding the execution of the project without the delays. The practitioners can able to understand the potential of the management of the project and reduce the causes of the delays in the executions.

REFERENCES

[1] Ayman H. Al-Momani [2000] "Construction delay: a quantitative analysis" International Journal of Project Management, Vol-18 (2000) pp - 51-59.

[2] Sadi A. Assaf and Sadiq Al-Hejji [2005] "Causes of delay in large construction projects" International Journal of Project Management, Vol-24 (2006) pp - 349-357.

[3] Murali Sambasivan [2006] "Causes and effects of delays in Malaysian construction industry" International Journal of Project Management, Vol-25 (2007) pp - 517-526

[4] Divya. R and S. Ramya [2015] "Causes, Effects and Minimization of Delays in Construction Projects" NCRACCESS-2015, ISSN: 2348-8352, pp – 47-53.

[5] Hamzah Abdul Rahman, Chen Wang, Roshana Takim and Szemin Wong [2010] "Project schedule influenced by financial issues: Evidence in construction industry" Journal of Scientific Research and Essays Vol. 6(1), pp – 205-212.

[6] Ibn-Homaid N. T. and Tijani I. A. [2015] "Financial Analysis of Construction Company in Saudi Arabia" International Journal of Construction Engineering and Management, Vol. 4(3), pp – 80-86.

[7] Al-Barak AA. Causes of contractor's failures in Saudi Arabia. Master thesis, CEM Dept., KFUPM, Dhahran, Saudi Arabia, 1993

[8] Chan DW, kumarswamy MM. A comparative study of causes of time overruns in Hong Kong construction projects, Int J Project Manage 1997; 15(1); 55-63

[9] Alkass S, Mazerolle M, Hassis F. Construction Delay analysis technique, Construction Manage Econ 1996;14(5);375-94

[10] Aibinu AA, Jagboro GO. The effects of construction delays on project delivery in Nigerian construction industry. Int J Project Manage 2002;20;593-9.