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DELAY ANALYSIS IN CONSTRUCTION

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Abstract - *Delay in construction project has negative effect on clients, contractors and consultants in the term of growth in their relationships, mistrust and cash flow problem. Completing the projects on time is an essential part of construction process and these are subjected to many variables and unpredictable factors which result from many sources and it is necessary that a detailed assessment is to be conducted and calculated the losses raised due to delay in projects. As a methodology, the participants involved in the survey are handed over with the questionnaires by using the Google forms, through Whatsapp and mails and atlast suggestions to reduce the delay in projects from the respondents were included in the form. The responses were collected from contractors, students, clients and consultants. There were total of 57 respondents in which 14 are clients, 31 are contractors, 4 consultants and 8students. It concluded the top ten causes for the delay in construction projects from survey.*

Key Words: (Size 10 & Bold) Key word1, Key word2, Key word3, etc (Minimum 5 to 8 key words)…

1. INTRODUCTION

Construction projects are one of the most important factors in supporting the socio economic development of the country. The private sector includes the role of clients and contractors while in the government sector includes the role of contractor and government officials appointed by the government. Both the sectors are binded by the "contract" called document which includes all the data such as estimated cost, quality, and time. The primary goal of the contract is to complete the project as specified according to plans on schedule, within the budget and achieve the best quality. When the project is not completed within the specified time and budget.

1.1 Definition:

"Delay in construction industry is the time lag or extra time taken to complete the ongoing projects due to various factors affecting on it due to client, contractor, consultants or other agencies".

1.2 Objectives of the Study

- To determine the major causes of the delay and divide them into the several categories
- To avoid the project failure or loss which is important to detect the causes at early stages.
- To analyze the causes of delay due to contractor, consultant or owner's mistakes and prioritize.
- To study and understand the effects and change the scheduling in the execution phase..
- It helps to minimize the delay in projects and helps in reducing the loss incurring in theprojects.

1.3 Literature Review

Tsegay Gebrehiwet and Hanbin Luo This study involves the analysis of the delay and its causes at different stages of construction in the Ethiopian city. In this it involves the questionnaire with 52 causes and 5 Effects of delay and data were collected from 77 participants from different organization. This study involves the method of Relative importance index and post construction sequentially.

Jawad A. Alsuliman The author conducted a survey on delay faced in Saudi Arabia. He has included 50 delay factors and 211 participants were considered and responses were collected. In this top 20 causes were indentified and final simplified formula was developed to calculate the effect of each cause of delay onsite. This study mainly considered the part of the government work and was awarded with ranking.

Mohamed M. Marzouk and Tarek I. El-Rasas The main purpose of this study is to identify the delays in construction projects in Egypt. He stated that the problems occur due to disputes and litigation with different parties. The feedback of the construction experts was obtained through interviews, subsequently a questionnaires was prepared. The survey was carried out from 33 experts who represent owner, consultants and contracting organization. He used frequency index, security index and importance index was calculated.

N. Hamzah, M. A. Khoiry, I. Arshad, N. M Tawil and A.I. Che Ani In this study it has been discussed aboutconstruction delay in Malaysia. They have given delaya definition as time overrun or extension of time to complete the project. It has been summarized as delay is a situation where actual construction project is slower than the planned scheduled. It involved the category of two

types, excusable and non excusable delay. Furtherranksweregiventothefactorswiththehelpof Relative importance index (RII).

Murali Sambasivan The main purpose of this paper was to identify the factors and effects on the construction projects in Malaysia. The author has considered both factors as well as effects and had made an simultaneously impacts on them. He has collected the survey the survey from contractor, consultant and clients and the responses were collected. The survey included various factors such as planning, site management, finance, labour efficiency, material management, cost overrun, disputes etc and also gave the interrelation between them.

H. Abdul Rahman, M. A Berawi, A. R Berawi, O. Mahamed, M. Othman and I. A. Yahya The paper describes the main role of applying proper management system helping in avoiding delays in construction projects. The interview before the survey helps in determining the factors of survey and their effects. This survey included 502 participants in which 8 clients (2%), 81 consultants (16%), and 413 contractors (82%). It included 16 interviews in which 6 were senior engineers, 2 designers, 6 project manager and 2 assistant project manager. It has concluded saying that intensive management involvement is considered as main purpose of delay.

Tommy Y. Lo, Ivan W H fung and Karen C. F. Tung This paper relates the information of the delays that are caused in projects in Hong Kong which includes contractual claims and increase in project cost. It includes the responses from 158 civil practitioners from Hong Kong including client, consultant, and contractor from different age groups. It concluded the research by saying that the delay occurs due to unforeseen ground condition, poor site management , client variation in experienced contractors, slow coordination, seeking the approval authorities, poor supervision, and inadequate resources and reducing cash flow problems.

Ibrahim Mahamid, Amund Bruland, and Nabil Dmaidi In this paper the researcher referred the delay in Road projects. Surveys were collected from professionals such as contractors, clients and consultants. The survey obtained are then analyzed using relative importance index(RII). The top groups affecting the delay in construction are: equipment, design, contractor, material, contract and lastly awarding the tender to the lowest bid price.

2. METHODOLOGY

The current study is carried out from the earlier studies by researchers on delay analysis with its effects and causes in the execution phase. Questionnaires were prepared by contacting the people of experienced one's and was take into Google forms as survey, responses were collected from contractors, consultants, students, and clients. The responses collected were then analyzed and given a rank with the help of RII.

2.1 APPROACHES FOR THESTUDY

- Study of Literature Review.
- Collection of causes from expertise.
- Determine the causes collected from literature review.
- Preparation of questionnaire using google form.
- Distribution and data collection using survey.
- Calculation and Analysis using RII.
- Results and Discussion.

2.2 DESIGN OFQUESTIONNAIRE

The participants involved in the survey are handed over with the questionnaires by using the Google forms, through Whatsapp and mails .This contains the information of the parties name, age group and the type of designation like students, client, consultant or contractor ,further these questions are related on the causes of the delays ,the participants are asked to judge the importance level of each causes these are mainly classified into groups.

2.2.1 Contractor Related Factors

In this it includes the delay in obtaining the work order from the government before start of the work. It also includes the experience levels; change of subcontractors the usage of obsolete technology, site management, site supervision or provision of sufficient labours.

2.2.2 Materials related factors

In this type of delay it include the unpredictable increase in the price of materials it may be due to increase in the price of raw materials or increase in the price of transportation. Tax burdens are the factors which is related to the government.

2.2.3 Client RelatedFactors

The cash flow from owner is the important aspect due to which contractor may either held the development of work, change of plan from the owner during execution phase. Decision making by the owner during due to payment over progress, interference of the owner during execution phase.

2.2.4 Variation of Orders RelatedFactors

These includes the data of the communication gap between the owner and contractor or it may be between contractor and labours, in some cases the owners give direct orders to labours which may give the labours in

confusion whether to follow the owners orders or contractors ones.

2.2.5 Consultant RelatedFactors

In this it includes the data of poor estimation mistakes created, improper drawings provided that is missing of data such as dimensions, billing quantities missing, late inspection occurred by consultants, approval of quality inspections.

2.2.6 Various OtherFactors

The other factors such as poor documentation of land, land disputes, natural calamities such as floods or earthquake, pandemic situation such as COVID, transportation facilities, tendering procedure of selecting the lowest bidder, political issues, time overrun and cost overrun.

The five point scale which was collected from respondents was converted into RII which helped in ranking the factor:

$$RII = \frac{\sum W}{(A \times N)}$$

Where W is the answer of the respondent for each of the variables, A is the highest response of the same factor and N is respondent numbers. RII ranges from 0 to 1, lower the value of RII less important factor it is going to be and higher the RII valve more important factor it is going to be. This Collected RIIs will be used to evaluate responses of the respondent. The entire three group's replies will be differentiated based on the replies. The same process is also used for the analysis of effects.

3. Calculations and Analysis

As it is very difficult to collect the data personally from the individual in their busy hours, it will be helpful to gather their personal views through social media, hence by using web "Google form" questionnaire was designed and shared to either Whatsapp and mails to the contractors, students, consultant and contractors as this is the faster means of gathering the information. The collected information involves 31 contractors, 14 clients, 4 consultant, and 8 students. Suggestions were carried at last in the Google form this was included so that no missing factors can be seen and it can be carried free of cost. The questionnaire first involves the information about respondent's data such as name, age group, organization and then followed by the 35 questions framed on the factors with ratings from 1 to 5 not important to very important respectively. Each factors are then calculated using RII using formula.

3.1 SUMMARY AND RESULTS

The information collected from survey are calculated and analysed the analysed data is summarized using Table 1.

Based on the ranking, from the Table 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.

These below causes are the top ten causes related that occur delay in construction industry carried out from survey through expertise. These analysis includes the survey from all the expertise those are contractors, consultants, students or clients.

Now from below we have concluded the information from all expertise let's look on to the individual experts Table no 2 are the causes stated by contractors they are: i) Due to Pandemic situation a such as COVID 19 with RII value is 0.79 ii) Due to natural calamities such as floods with RII value 0.76 iii) Due to payment over progress with RII value 0.75 iv) Due to land disputes with RII value is 0.74 v) Due to transportation facilities with RII value is 0.73.

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 information it can be seen that there is huge affect of Pandemic situation other factors are included and is caused due to mistakes of either parties. The natural calamities are affected by the natural actions so it cant be prevented other causes can be avoided by proper actions.

From the Table 3 the cause of delay in project according to Clients are as follows: i) Due to Pandemic situation such as COVID 19 with RII value is 0.86 ii) Due to payment over progress with RII value is 0.84 iii) Delay due to frequently change of subcontractors with RII value 0.80, iv) Due to Poor documentation of land with RII value 0.77, v) Due to tendering procedure of selecting of lowest bidder with RII value 0.73.

From the above details it can be seen that huge effect is due to pandemic situation.

From the Table 4 the causes of delay in projects according to students are as follows: i) Due to Pandemic situation such as COVID 19 with RII value 0.88, ii) Due to cash flow from owner with RII value 0.85 iii) Due to interference of the owner with RII value 0.83 iv) Due to transportation facilities with RII value 0.80 v) Due to cost overrun beyond estimate with RII value 0.78.

From the Table 5 the causes of delay according to consultants are as follows: i) Due to cash flow from owner with RII value 0.9 ii) Due to non availability of materials and equipments with RII value 0.85 iii) Due to transportation facilities with RII value 0.8 iv) Due to delay in obtaining work order (for government contracts) with RII value 0.75 v) Delay due to poor site management and supervision with RII value 0.7.

Table 1 Details of RII and Ranks of factors by All Types of Respondent

Causes of delays	Percentage of Respondents						RII	Rank
	1	2	3	4	5	Total		
Delay due to contractor								
Obtaining work order	3.5	22.8	24.6	42.1	7.02	57	0.653	13
Lack of experience	3.5	36.8	15.8	33.3	10.5	57	0.621	24
Frequently change of subcontractors	0	17.5	21.1	49.1	12.3	57	0.712	7
Usage of obsolete technology	1.8	24.6	31.6	33.3	8.77	57	0.646	16
Poor site management and supervision	3.5	33.3	10.5	29.8	22.8	57	0.67	11
Insufficient labours	11	21.1	22.8	26.3	19.3	57	0.646	17
Fluctuation in market								
Unpredictable increase in the price of materials	7	31.6	21.1	33.3	7.02	57	0.604	26
Increase in the employee wages	14	28.1	26.3	26.3	5.26	57	0.561	27
Increase in tax burdens	14	35.1	21.1	19.3	10.5	57	0.554	28
Slow growth in the market	3.5	35.1	14	31.6	15.8	57	0.642	18
Non availability of materials and equipments	0	24.6	24.6	33.3	17.5	57	0.688	9
Rising interest rates	12	35.1	15.8	33.3	3.51	57	0.561	27
Delay due to owner								
Cash flow from owner	3.5	15.8	15.8	38.6	26.3	57	0.737	4
Change of plan during execution phase	8.8	24.6	24.6	29.8	12.3	57	0.625	23
Decision making by the owner	7	35.1	7.02	36.8	14	57	0.632	21
Payment over progress	1.8	21.1	12.3	22.8	42.1	57	0.765	3
Interference of the owner	1.8	28.1	22.8	38.6	8.77	57	0.649	15
Variation on orders								
Communication gap between owner and Contractor	1.8	35.1	19.3	35.1	8.77	57	0.628	22
Communication gap betwen contractor and labours	8.8	28.1	17.5	33.3	12.3	57	0.625	21
Direct orders given by owner to labours	8.8	22.8	19.3	36.8	12.3	57	0.642	18
Consultants								
Poor estimation by consultants	14	24.6	12.3	35.1	14	57	0.621	25
Improper drawings provided by the consultants	3.5	24.6	24.6	36.8	10.5	57	0.653	14
Billing quantities by consultants	11	31.6	28.1	26.3	3.51	57	0.561	27
Late inspection of sites	12	17.5	22.8	40.4	7.02	57	0.625	23
Inadequate experience of consultants	5.3	29.8	17.5	36.8	10.5	57	0.635	20
Approval of quality inspections	5.3	19.3	26.3	40.4	8.77	57	0.656	12
Various factors								
Poor documentation of land	3.5	21.1	17.5	40.4	17.5	57	0.695	8
Land disputes	1.8	14	28.1	33.3	22.8	57	0.723	6
Natural calamities such as floods	0	10.5	17.5	45.6	26.3	57	0.775	2
Pandemic situation such as COVID 19	1.8	10.5	12.3	31.6	43.9	57	0.811	1
Transportation facilities	3.5	12.3	21.1	42.1	21.1	57	0.73	5
Tendering procedure	0	22.8	26.3	38.6	12.3	57	0.681	10
Political issues	1.8	29.8	24.6	35.1	8.77	57	0.639	19

Time overburden beyond completion date	8.8	43.9	15.8	24.6	7.02	57	0.554	28
Cost overrun beyond Estimate	14	17.5	24.6	31.6	12.3	57	0.621	25

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

Rank	RII	Contractors Percentage					Causes of delay according to contractors
		5	4	3	2	1	
1	0.79	38.7	32.3	16.1	13	0	Due to Pandemic situation
2	0.76	19.4	54.8	12.9	13	0	Due to natural calamities such as floods
3	0.75	35.5	25.8	16.1	23	0	Due to payment over progress
4	0.74	22.6	32.3	35.5	9.7	0	Due to land disputes
5	0.73	12.9	51.6	25.8	6.5	3.2	Due to transportation facilities

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

Rank	RII	Clients Percentage					Causes of delay according to clients
		5	4	3	2	1	
1	0.86	50	35.7	7.14	7.1	0	Due to Pandemic situation such as COVID 19
2	0.84	64.3	7.14	14.3	14	0	Due to payment over progress
3	0.8	14.3	71.4	7.14	7.1	0	Due to frequently change of subcontractors
4	0.77	28.6	42.9	14.3	14	0	Due to Poor documentation of land
5	0.73	14.3	50	21.4	14	0	Due to tendering procedure

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

Rank	RII	Consultants Percentage					Causes of delay according to consultants
		5	4	3	2	1	
1	0.88	50	37.5	12.5	0	0	Due to Pandemic situation
2	0.85	37.5	50	12.5	0	0	Due to cash flow from owner
3	0.83	37.5	37.5	25	0	0	Due to interference of the owner
4	0.8	37.5	37.5	12.5	13	0	Due to transportation facilities
5	0.78	37.5	37.5	12.5	0	13	Due to cost overrun beyond estimate

Table 5 Details of RII and Ranks of factors by All Students Respondents

Rank	RII	Consultants Percentage					Causes of delay according to students
		5	4	3	2	1	
1	0.90	50	50	0	0	0	Due to cash flow from owner
2	0.85	75	0	0	25	0	Due to non availability of materials and equipments
3	0.8	50	25	0	25	0	Due to transportation facilities
4	0.75	25	25	50	25	0	Due to delay in obtaining work order
5	0.70	50	0	0	50	0	Delay due to poor site management and supervision

From the above analysis the top ten causes of delay in construction are as follows:

i)Due to pandemic situation such as COVID19:

The RII value of this factor is 0.81. The situation of COVID 19 has affected the global conditions of working environment. This situation has not only affected the market condition. There are many fluctuations in the market such as sudden downfall or sudden raise. The labours travelled long from their home states to different states for their earnings as a job left the work and have returned to the home in which there is slow progress of construction. Most of the people in construction industry are from different states which come together to make a successful project but situation like this has made a big loss to the industry in completing projects. Even the materials availability has been affected due to lockdown of overall country there was difficulty in transporting the raw materials for the production which intern made a shortage of materials.

ii) Due to natural calamities:

The RII value of this factor is 0.77. These includes the actions which occur naturally by the acts of god. Buildings that are under construction are mostly affected so the area that is under the natural disaster preventive measures must be taken to avoid them. Every construction site before starting it is very important to study the geographical data of that particular area. Taking precautions helps in avoiding occurringit.

iii) Payment overprogress:

The RII value of this factor is 0.76. These causes are for those who work under the conditions of contract upon the conditions of contract. These conditions include payment over particular stages if the owner denies over the payment at the completed stage then this cause is arrived. The contractor stops the work wherever the work is at that stage for the payment. So the contractor as well as client is responsible for this condition.

iv) Cash flow fromowner:

The RII value of this factor is 0.73. The cash flow from the owner is an important to construct in faster rate. These are the payments which are not included in the contract., the contractor needs some advances before going to any stage this flow is an important cause. These advances are required to bring any raw materials as well as labours in advance of start of the work. The cash flow helps in smooth running of the projects. This causes are mostly seen in the private sector. Most of the government sector includes the payment of bill after the completion of work.

v) Transportationfacilities:

The RII value of this factor is 0.72. The transportation is an important factor which is considered at initial that is starting till finishing of completion work. The production of the finished goods is also affected. This includes the shifting of materials from the plants to site from one place to other, even the equipments which are required for the construction require transportation. The materials required on site are transported in advance so that there is no pause in the work. Many of the advanced technologies of construction requires regular shifting . Use of advanced technologies is must because it helps in rapid completion of large scaleprojects.

vi) Due to land disputes:

The RII value of this factor is 0.71. These are the problems which are faced due to land related issues. These include the illegally occupying of lands by other parties. It may occur due to time, financial or workmanship and the relationships between the parties involved in it. This dispute may also seek an involvement to court or civil litigation which will cost each party in loss of money as well as time. Political and economic trends are resulting in disputes from careless design and improper construction practices. Compromising is the solution of thisproblem.

vii) Frequently change of subcontractor:

The RII value of this factor is 0.70. Whenever the contractor is not satisfied with the work carried out by the sub contractor with accordance to time, quality or cost he intends to change them. So the subcontractor chosen should be well experienced in the particular area, subcontractor should have advanced well equipped technology to finish the work faster even the consideration of labours under him plays an important role.

viii) Due to poor documentation ofland:

The RII value of this factor is 0.69. This includes all the legal proceedings before start of the work such as permission letter and work orders in case of government works. The proper distribution of ancestral property owned by previous owner and present owner with proper area owned and plans of the approved by the officials. Even before building we need approval from the municipalities. The documents should be clear enough to move for furtherproceedings.

ix) Non availability ofmaterials:

The RII value of this factor is 0.687. Construction material management is recognized as one of the finest part of construction industry, it includes material purchasing, storing and distribution at required stage in particular time. When these conditions arrive it may likely be called as shortage of materials at site which affects the duration of the project. For very efficient project proper availability of

materials are required. Even many software's are included for the material management at sites. So proper scheduling of material procurement is needed.

x) Tendering procedure of selecting of lowestbidder:

The RII value of this factor is 0.680. Tendering is the process in which contractors are invited for bidding. In this interested contractors can fill the tendering forms and the contractor should have the previous work done of the tenders are applicable. The contractors are given with start of submission date, end of submission date and open of tender date. The start of submission is the date where the data required for that tenders are filled and submitted before the last date of submission. Then opening of tenders includes the cross check of the datas submitted, and the tenders are awarded to the contractor who bids are lowest with respect to other with all datas perfectly matching.

4. CONCLUSIONS

The study of the causes of delays includes the analysis of delays in construction industry, this analysis helps in determining the important causes and to avoid them to reduce the impact on cost and time overrun. The main objective of the analysis is to guide project manager more understandable regarding its causes and minimizing its effects on the construction project.It includes the surveys that were carried out from the expertise in the construction field who are working in different companies or may be running their own companies. The experts have also given suggestions which are faced during execution of the work and not included in the survey. From this survey the analysis of each causes were calculated with the help of RII and the most factor affecting are determined. The important factors are: Due to pandemic situation such as COVID 19, natural calamities, payment over progress, cash flow from owner, transportation facilities, land disputes, frequently change of subcontractors, poor documentation of land, non availability of materials, and tenderingprocedure.The above results obtained also guides contractor, consultant, and client regarding the mistakes that are caused by them and reducing them making a project successful. The effects of project such as cost and time overrun can be avoided with the analysis of causes of construction project.

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