

Use of Delphi Technique for Scheduling of Highway Project

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Abstract: The main aim of the research paper is to solve statistical problems through Delphi method and get the time as well as cost effective result in linear construction in highway projects. Since last two decades Delphi technique enchanting the researchers to modify the use in construction Management. Few of them are examining the method closely and found that it will help to resolve the project management issues. In Delphi technique the team of experts analyzed the issues in different rounds and gave their feedback report. In this study we will collaborate the Delphi method with other methods such as CPM, PERT to obtain the appropriate evaluation to achieve the project targets in time without any failure and indirectly it affects on budget of the project. We will study the parameters using Delphi technique with preparing questionnaire survey which plays crucial role in project monitoring and execution.

Keywords — Delphi Method, Construction management, Questionnaire Survey

I. INTRODUCTION

The Delphi technique came from American defense unit. At the beginning of cold war to fulfill the necessity of forecasting the influence of technology on military operations the Delphi technique developed by RAND project during the period of 1950-1960s by Nicolas Recher and Helmer.

This method is approaches towards the solving complex problems with help of team of experts. The method refers the process where agreement among the group of people reached through the round of opinion of facilitator's observation and assessment on the subject (Gambatese 2010). Sometimes the finding solution from the Delphi may face difficulties due to time limitations it affects on survey data, inadequate knowledge of experts wrong choice of experts affects deeply on Delphi technique (Keeney 2001).

The duration of project, productivity and the cost are interconnected with each other slight variation directly affects on each other. However the precise forecast of duration of the particular activity is most important in linear road project to increase the percentage of output. The Delphi technique as a quantitative as well as qualitative or mix researched method. The group of 10 to 15 peoples having experienced in particular field can be sufficiently gave result. Previous study of Delphi shows only three facilitators are sufficient to obtain the result and the three rounds of data collection is sufficient to reach the conclusion. The statistical analysis of Delphi results positive approach towards scheduling linear road project

and gave real time data. There are some particulars which has more impact on the highway projects can be neutralized and enhanced the project management in road construction.

II. DELPHI TECHNIQUE OVERVIEW

Delphi technique is taken into account as a series of survey wherever every questionnaire embody the outcomes of the previous one. In theory, the technique iterations will continue, till the determined accord obtained. Poor response rate is common within the Delphi technique as a result same form could also be sent to identical panelists. If critics terminate his/her participation in any round, the standard of knowledge obtained may be out of print or inaccurate. The feedback method permits and encourages the critic to re-assess. Therefore, a mean of forty five days is needed for application of the Delphi. For time management between round, time period for panelists to reply is inspired. The physical meeting may be control with every professional singly may increase the accuracy. The Delphi method is handiest once analysis technique alternatives don't seem to be viable or once constraints exist that can't simply be overcome when making an attempt to assemble impartial information. However, in the non-appearance of a recognized group of consultants the Delphi method cannot be applicable.

III. NEED OF STUDY

From the review on planning ways presently utilized in the development trade, it's clearly understood that the compatibility of the planning tool is only depend on the sort of project, its element tasks and their production rates and nature of relationship between them. so it becomes necessary for project planning to depict the truth of the development method in an exceedingly project. Construction management has lots of challenges while executing the project such as Land acquisition, local problems related to PAP's , efficiencies in DPR, Forest clearances, utility shifting etc. This kind of problems always affects on the cost and duration of the project and indirectly affects on quality and quantity of project. So we need to improvised the implementation process with help of expertise's who had experienced in removal of such kind of huddles. Project planning with different methods such as CPM, PERT etc. are required to improvise to resolved timely occurring issues. In previous study it seen that Delphi technique is suitable in management of projects where time bound activity immensely affect on linear highway projects.

IV. OBJECTIVES

There are few work areas where scheduling based on productivity, resource requirements, simulation etc. However the concepts of consensus on production rates and their importance with respect to determination road project durations. Therefore the following objective has been taken for this work.

- To evaluate the important activities and their relationships on the basis of production rate by considering influence factors.
- To Study and improvise the methodology of scheduling road projects using Delphi technique
- To use Delphi technique with Beta distribution which is use in PERT to find out best possible way of executing a project by finding the over plan percentage.

V. LITERATURE REVIEW

The approach of the study is feasible solely by associate analysis of the sooner works completed in this functional area and reviewing existing literature associated with methods used for planning, the productive quality and price overrun within the road projects.

Wesam S.A., Mohd Shahir and Noor Amila(2015) The Delphi technique could be a methodology seeks to attain a accord among panel of experts. The accord is gained through a sequence of rounds. The feedback data passed to panelists by questionnaires. The technique an application being more and more concerned in construction management (CM) researches and it's been applied wide in

several disciplines. This quality meant that cheap and correct results are gained victimization Delphi technique. In this study the aim is to analysis critically urban center technique as a strong and systematic knowledge assortment tool in CM. Discussion and review centered on the procedures of application, cons and execs and also the technique key aspects. These key aspects enclosed experts' choice, anonymity, rounds and feedback; have been investigated through 10 revealed articles in CM. Delphi technique has vital chance to be used wide in gaining accord among CM analysis. This text provides rigorous guidelines for the technique application in CM to confirm bias elimination and also the outcomes validity and dependability.

Kirun S.S., Varghese S. (2015) Construction project set in Ernakulam, Kerala suffer from several issues and complicated problems. Consequently the target of this paper is to spot the varies factors poignant the performance of native construction comes and to elicit perception of their relative importance. A literature review was conducted to spot major issues. The techniques used for determine the matter is Delphi techniques. Exploitation Delphi techniques the form survey was contacted.

Ameyaw, Yi Hu, Ming Shan (2014) The delphi technique should be utilized the analysis technique by a growing range of researchers within the field of Construction Engineering and Management in past twenty years. Though variety of studies square measure offered on the employment of delphi, few researchers totally examine the potential of the delphi technique within the combined use of applied math techniques, that is inevitable trend for future Delphi analysis. This paper reviewed the incorporate utilization of Delphi and different quantitative ways within the CEM field supported a well furnished literature review of eighty eight relevant papers. These review results offer sensible references for analyzers having interests in applying Delphi technique in CEM research.

Grisham (2009) the delphi method to be designated for researching project management problems and issues has been given. It absolutely was over that the city technique could be a qualitative survey technique that's similar temperament for the analysis of advanced problems. The Delphi technique doesn't provide the rigorous testing in clinic however it dispense a scientific system of method that's similar temperament to problems that need the insights of an issue matter.

Zami and Lee (2009) argued city as a research technique with participants of professional panel responding to a series of questionnaires to realize a agreement in distinctive the factors influencing the widespread adoption of stable earth construction to handle the low value housing crisis.

Skulmoski and Krahn (2007) instructed that the city methodology could be a versatile analysis technique similar temperament once there's incomplete data a few phenomena and another that it's not simply a quantitative methodology, however works alright in qualitative analysis.

Arun and Nursingd Rao (2007) addressed an innovative call Support Tool that might predict the length overrun cost and activities related to any specific delay in main road construction comes. Simulation models for length and value overrun of the project was developed supported the character of delay, activities related to the delay and classified as manageable and uncontrollable factors. Supported the opinion of senior project implementers from sixty four consultants and professionals in main road construction sector of Asian nation, the most risk factors were categorized during this work. The data based mostly call Support Tool (KBDST) was developed to produce a project watching tool to gauge the chance related to the delays within the main road construction comes. KBDST had Java development simulation model to get a dynamic cognitive content for value and length overrun for main road construction comes. The length and value overrun for the activities plagued by the delay was obtained as output from this model.

Cekic (2004) Applications of the city technique was instructed by conducting four rounds of city in distinctive exclusive criteria for choice of comes for international project portfolio of Serbian construction firms and to derive agreement within the weight of utility factors in numerous international markets.

Sharma (2004) The actual issues connected with main road comes of huge size with illustrations from one in every of the packages of the Golden Quadrilateral project spanning between Old Delhi and metropolis, Asian nation was reportable. A close study was created during this work with regards to the project administration, work program and therefore the overall performance of the project by completely work on one in every of the work packages that relatively had a smaller length and lesser issues. The work mentioned the contents of the elaborate project report (DPR) and therefore the contract documents and reviewed the targeted and actual accomplishments in terms of value and length. The entire technical reasons touching the progress of labor was summarized and therefore the anticipated delay for the study package was calculable at 10 months and twenty four days with the anticipated value falling below the contract quantity by agency seventy four million. The opposite packages were even expected to be delayed by sixty to seventy percent from the contract amount. Providing land freed from encumbrances, time needed for mobilization, imports, leases, joint venturing, bidding practices, time taken for revision of bill of quantities and elaborate Project Report (DPR), lack of other

proposals, slow deciding etc were reportable because the major reasons for the delay of the project.

Ellis and Randolph (2003) Basic causes of delays in construction comes were outlined as things and conditions in spare detail that desecrated the elemental principles to permit corrective action to be taken. an inventory of most typical basic causes categorized beneath seven major classes like business practices, procedures, utilities, website conditions, coming up with and programming, traffic management and style errors has been provided. Though the survey for delay from each expressway and constructors were listed one by one, it absolutely was found that almost all of them were common for either side.

VI. METHODOLOGY

1. Selection of Facilitator

The first step of Delphi method is selection of Facilitator. The facilitator may be the employee of the same organization or can be external personal that has adequate experience and knowledge. The facilitator should be neutral person who has experience in research and data collection.

2. Data collection and preparation of questionnaire

The second step toward implementing the Delphi methodology is to prepare the method during very specific and thorough manner. Questionnaires ought to be designed, administration processes determined, cost and possibility of problems should be evaluated before beginning the particular procedures.

3. Selection of group of experts

The third step is selection of group of experts where the expert may be the employee of the same organization or can be external person who has adequate experience and knowledge. The size of the project being completed can confirm the amount of knowledgeable panels the Delphi technique needs; however every panel ought to include roughly five to twenty members. The scale of the panel is ultimately determined by the requirements and budget of these administering the method. An easy sampling of respondents isn't adequate type this panel. The total premise behind the Delphi theory is that the panel members are in reality consultants in their field so as to yield additional correct results.

4. Second round of Questionnaire

The second round and also the rounds later area unit organized questionnaires together with feedback. Accord is improved through controlled feedback, throughout the economical and fast assortment of consultant's opinions. Within the second round, panelist's area unit needed to rate things to determine priorities.

5. Third round of Questionnaire and analysis

The new forms are going to be sent within the third round, which contains outline of the factors rank and feedback. Every professional is asked to revise his/her opinion and to specify the explanations for remaining outside the consensus. During this stage, a cut-off purpose ought to be known, thus a number of the factors may be omitted from consequent form. In the next and frequently the ultimate round, the things that reaching accord area unit sent to the consultants. This round offers a final likelihood for the panelists to review their ranks. The amount of rounds relies on offered time and accord. Conversely, this has been custom-made to match the study objectives and will be attenuated to 2 or 3 rounds. This method continues till an accord is reached by the cluster. Sometimes a minimum of 3 questionnaires is required to succeed in an accord; however the amount of questionnaires may be 5 or additional as per the research of facilitator it may vary with project to project.

6. Analysis and Result

The facilitator will collect the data and tabulate it such a manner that every activity delay percentage can be calculated by using all influencing factor and that overrun percentage will be calculate by using beta distribution which is use in PERT.

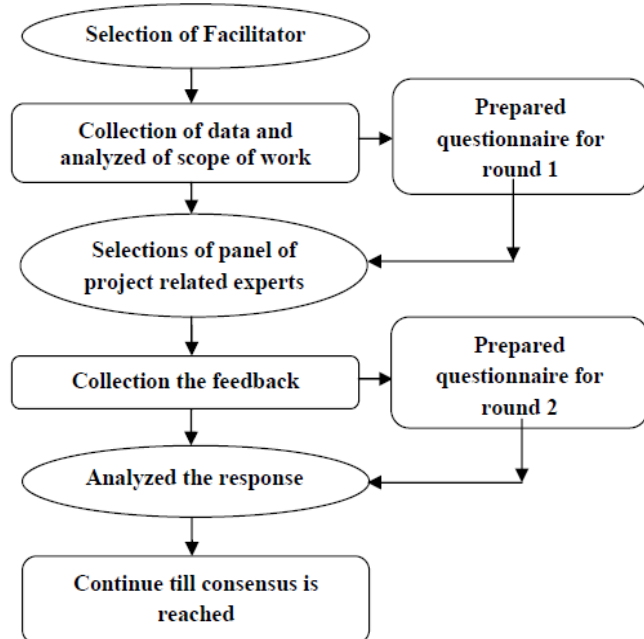


Figure 1: Flowchart for Delphi Technique

VII. ANALYSIS AND RESULT

The collection of information from the survey was analyzed exploitation descriptive applied mathematics techniques. a sophisticated and correct analysis technique was required to rearrange the massive body of knowledge in a very systematic, quick and reliable manner. For this purpose the excel stand out was chosen because the best choices out

there. The respondents should asked to gave rating to causes of delay in projects and how the factors affect on projects with reference to their frequency and severity weight. The scales provided the over time proportion. The quantitative measures of the frequency and therefore the severity were obtained exploitation a similar scale that was assigned to them. The methods such as CPM and PERT are use for reference which are activity oriented and we can calculate Optimistic time prediction, Most likely time prediction and Pessimistic time prediction. The tables of factors and activity in percentage are obtained as bellow:

Activity Factor	Preparation of DPR (in percentage)			Land Acquisition (in percentage)			Site preparation (in percentage)		
	a	m	b	a	m	b	a	m	b
Lack of Design or planning	0	4	12	5	9	18	0	3	9
Inexperience of staff	2	6	11	8	12	20	0	4	8
Poor leadership	3.5	9	16	6	11	16	0.5	4	6
Non Availability of Resource	0	2	4	3	9	15	2	7	15
Additional work	0	2	4	2	8	15	0.5	6	11
Rework	0	0	0	0	0	0	0	0	1
change of scope	0	0.5	5	0	7	13	0	3	7
Obtaining statutory clearances	0	0	2	0	2	6	0	3	8
Site condition	0	0.5	4	0	3	5	1	5	11
Any other (Due to PAP's)	0	3	5	4.5	10	18	2	5	8

Maximum Estimated Time= (a+4m+b)/6

Where,

a = Optimistic Time

m = Most likely time

b = Pessimistic Time

Estimated time Preparation of DPR

$$= (1 \times 1.02 \times 1.035 \times 1 \times 1 \times 1 \times 1 \times 1 \times 1) + 4(1.04 \times 1.06 \times 1.09 \times 1.02 \times 1.02 \times 1 \times 1.005 \times 1 \times 1.005 \times 1.03) + (1.12 \times 1.11 \times 1.16 \times 1.04 \times 1.04 \times 1 \times 1.05 \times 1.02 \times 1.04 \times 1.05) / 6$$

= 6.562 % (Over Plan)

Therefore, The over plan percentage of Preparation of DPR is 6.562%.

Similarly,

The over plan percentage of Land Acquisition

$$=(1.05 \times 1.08 \times 1.06 \times 1.03 \times 1.02 \times 1 \times 1 \times 1 \times 0.045) + 4(1.09 \times 1.12 \times 1.11 \times 1.09 \times 1.08 \times 1 \times 1.07 \times 1.02 \times 1.03 \times 1.10) + (1.18 \times 1.20 \times 1.16 \times 1.15 \times 1.15 \times 1.13 \times 1.06 \times 1.05 \times 1.18) / 6$$

$$= 8.484\%$$

The over plan percentage of Site preparation

$$=(1 \times 1 \times 1.005 \times 1.02 \times 1.005 \times 1 \times 1 \times 1 \times 1.01 \times 1.02) + 4(1.03 \times 1.04 \times 1.04 \times 1.07 \times 1.06 \times 1 \times 1.03 \times 1.03 \times 1.05 \times 1.05) + (1.09 \times 1.08 \times 1.06 \times 1.15 \times 1.11 \times 1.01 \times 1.07 \times 1.08 \times 1.11 \times 1.08) / 6$$

$$= 7.34\%$$

Activity Factor	Preparation of Pavement (in percentage)			Utility Shifting		
	a	m	b	a	m	b
Lack of Design or planning	3	8	12	3.5	8	14
Inexperience of staff	4	9	15	4	11	18
Poor leadership	5	11	16	1	6	11
Non Availability of Resource	3.5	8	15	1	5.5	11
Additional work	1	5	12	4.5	10	15
Rework	3.5	8	13	4.5	11	17
change of scope	0	3	5	3.5	9	13
Obtaining statutory clearances	0	3.5	7	1	5.5	9
Site condition	0	6	11	1.5	5	10
Any other (Due to PAP's)	1	5	9	4	9	16

The over plan percentage of Preparation of Pavement

$$=(1.03 \times 1.04 \times 1.05 \times 1.035 \times 1.01 \times 1.035 \times 1 \times 1 \times 1.01) + 4(1.08 \times 1.09 \times 1.11 \times 1.08 \times 1.05 \times 1.08 \times 1.03 \times 1.035 \times 1.06 \times 1.05) + (1.12 \times 1.15 \times 1.16 \times 1.15 \times 1.12 \times 1.13 \times 1.05 \times 1.07 \times 1.11 \times 1.09) / 6$$

$$= 9.32\%$$

The over plan percentage of Utility Shifting

$$=(1.035 \times 1.04 \times 1.01 \times 1.01 \times 1.045 \times 1.045 \times 1.035 \times 1.01 \times 1.015 \times 1.04) + 4(1.08 \times 1.11 \times 1.06 \times 1.055 \times 1.10 \times 1.11 \times 1.09 \times 1.055 \times 1.05 \times 1.09) + (1.14 \times 1.18 \times 1.11 \times 1.11 \times 1.15 \times 1.17 \times 1.13 \times 1.09 \times 1.10 \times 1.16) / 6$$

$$= 10.525\%$$

VIII. CONCLUSION

There are several important factors that influencing the project activities in different way such as lack of design or planning, inexperienced staff, poor leadership, change of scope, obtaining statutory clearances etc. and the major activities are Preparation of DPR, land acquisition, site preparation, pavement work and utility shifting.

The Delphi process has led to the benchmarking of the optimistic, most likely and the pessimistic time estimates of linear activities for five major factors influencing project durations based on predictable delays. The procedures included panellist's choice, panel size, rounds range, feedback, and agreement measure and biases identification. By following the instructions pointers, valid and reliable results with minimum bias are expected. The questionnaire should be meticulously ready and piloted to avoid ambiguity. However, the possibility exists for low reply rates will be difficult and build its application time consuming.

The Planning and scheduling is the important part of every project it starts at DPR stage where the project actually getting the shape. As per the result the project gets over plan if the proper DPR is not plan it affects on overall project. The role of the project in charge team is perhaps the foremost necessary part in containing the cost of a project. It's usually true that poor projects with a decent project manager are going to be completed satisfactorily. However even a decent project, if combined with poor project management, can nearly always face serious difficulties. The poor leadership and lack of knowledge tend to increase the duration as well as cost of project in various starts to end activities. Proper planning and scheduling in project management plays important role in activity oriented projects.

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