



Delay Analysis in Residential Building Project using Genetic Algorithm

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ABSTRACT: Due to the inherent risks and increasing complexity of modern construction 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. Survey base delay analysis has been recognized as one of the most credible techniques for analyzing construction delays. Despite its benefits, survey analysis can produce different results depending on the collected data size, it can be consider owner and contractor acceleration, as well as systematically consider the impact of several baseline updates made due to changes in the duration and logical relationships of the activities, and it can consider the impact of the progress events on resource over-allocation and its consequent delays. This study proposes a survey base on analysis model that can considers multiple factors which can be effect on construction delays. In this work we proposed a Genetic Algorithm (GA) base fitness and recommendation approach, that we can consider the multiple factors has included in survey. Finally system will recommend the different ranked factors which are responsible for delay with graph. The overall research can be applicable for any kind of construction projects.

I.INTRODUCTION

Construction industry plays an important role within the economic process of a rustic through the multiple effects of the opposite sectors of economy. Construction is defined as a creation, renovation, repair and demolition of immobile structures and alteration of natural topography. It is somewhat just like the process to satisfy the desired demand of homeowners like modification of arrange specifications and resources within the project schedule, cost and quality. Due to the unique nature of construction project, knowledge gained in coming up with, scheduling and dominant construction method is seldom unfold. This results in value of in-efficiency that is being incurred as a requiring cost. By taking the expenditure of construction industry, the Project Management profession became much valuable in order to create positive the project goes in an exceedingly right track to complete with success. Delays are one of the main complications facing by the building production. The interruptions in building plans have weighty economic and public effect to all parties involved in the projects. Construction interruption is a main difficulty facing by the building industry. In most construction projects, there are delays and their impact level varies from plan to project ranging since a few days to years. It is regularly understood that the building interruption is the greatest critical factors affecting to deliver the plan in time, within budget, and expected quality. It can be found rarely that a project was completed within the specified time. There are various negative belongings of delays such as proceedings among owners and contractors, increased costs, loss of productivity and income, and indenture finish. Effects of delays which mainly marks are loss of Interest by the Investor, prohibit by Consultants, unused of Money and Time, Declination of Reputation etc. Delays began by servicers can commonly be official to poor supervisory expertise. Lack of scheduling and a meager accepting of accounting and economic moralities have led to many a contractor's downfall. In this study, most critical factors causing delay and their effects in large residential construction projects in India A project is now thought of as a cluster of activates interrelated, which could embody a task of specialist and specific work oppression modern info and a gifted men out there to be direction taken in most organized protocols.

II.LITERATURE SURVEY

According to Patel and Jha, (2016), Foreign Direct Investment or FDI is considered to be another milestone strategy implemented by the Government of India. The most important aspect of FDI in terms of Indian construction industry is that it has allowed many foreign firms to invest in the industry more freely. The main aspect of the FDI is that the growth rate of the Indian construction industry has decreased over the past decade. As a result, in order to boost up the growth rate, there was a desperate need of investment. The FDI has helped the industry to acquire the needed investment in order to boost the growth rate. It can be also stated that the FDI has also helped the industry to share the technological aspects as well. This particular phenomenon has helped the industry to change its infrastructure to the

global level and at the same time-shared the technological advancements with the foreign brands as well. Another important fact, which should be mentioned, is the implementation of the GST bill. The GST bill is considered as one of the most important aspects in case of the costing of the industry. It can be stated that the GST bill has drastically reduced the costing of the essential materials needed for the construction projects. It should be noted that this reduction in the costing of the materials has gradually nullified the effect of inflation as well. As a result, the profit margin of the industry will increase eventually. This will help the entire construction industry to acquire a substantial amount of boost in terms of the growth rate. Though there is a sign significant amount of positive development of the Indian construction industry, there are several crucial challenges, which is still being faced by the entire industry.

As per the studies of Kona et al. (2016), it can be stated that the physical infrastructure of the country and the development of the physical infrastructure is also an important aspect as it provides the blueprint for the construction industry to develop in a significant way. Adding to this it can be also stated that the planning commission of India is currently planning to invest nearly 320 billion US Dollars for the development purposes of the infrastructure of the Indian construction industry. The 11th planning commission for the betterment of the industry has implemented this strategy. Another fact is that it also important to build a model or Public Private Partnership. As the construction industry of India is comprised of both the public and private sector, it is important to bridge these two separate categories into one so that the growth of the industry is not halted. Along with this, the management of risk and supply chain is also a crucial aspect as well. In many cases, it has been observed that the construction projects has been halted or delayed due to several issues into the risk management process of supply chain management. As a result, it can be stated that these two aspects of the construction industry should be developed as well.

According Akinwumi, (2014)proposed one of the most important strategies, which have been implemented by the government of India in recent times, is the Smart Cities projects. Other important projects which should be mentioned are the “Housing for All by 2022”, “Make in India Initiative” etc. the most positive aspects of these projects are that they have increased the impetus of the growth rate of the industry and its infrastructure as well. Another positive aspect is that all these projects consist latest technological aspects as well by author.

According to Shanmugapriya and Subramanian (2013), as the current growth rate of the industry is on the lower side, it is not reflecting upon the future prospect and potential of the entire industry. This aspect can be identified as one of the important factor as many economists have stated that construction industry is one of the most important pillars of the overall development of the country. However, it can be also stated that the government helps and initiatives is making the overall situation better in terms of investments and technological advancements.

According to the studies of Gohar et al. (2012), it can be stated that the Indian economy is facing a huge growth in recent times for the last couple of decades. As a result, it can be stated that it can be seen that majority of the infrastructure development industry has been progressed. However, despite all these positive aspects, the growth rate of the industry has not been on the higher side of the ten percent mark.

As per the studies of Doloi et al. (2012), it can be stated that the amount of investments and technological advancements is one of the major catalysts, which can improve the overall growth rate of the industry. This will also help to attract global brands to acquire significant amount of business in Indian construction industry. For the last couple of years many important and well-known global brands have entered the construction industry of India. For the purpose of intruding the essential change into the current framework of the Indian construction industry, the government of India has implemented several sorts of strategy for the betterment of the entire industry. The most important part of such government initiatives is not only to increase the growth rate current infrastructure of the industry. It also highlights the context of investment in the technological aspects to develop construction process effectively.

According to Pai and Bharath, 2013 for the better execution of the research, it is vital for the researcher to collect and obtain different sorts of relevant and important secondary data or information from authentic sources. These authentic sources may be articles, online databases, research journals, books, and projects. As a result, it can be stated that the literature review section of this research is important, as it will allow the researcher to collect important data regarding the Indian construction industry. This particular section will also provide important information regarding the theories, information, and concepts with respect to the subject of the study. As of now, in Indian construction industry, it is observed that many projects are delayed due to various reasons. In many cases, it is also observed that the reasons behind these sorts of delays have been identified but still the avoidance of these delays is not done yet.



According to Chaphalkar and Sandbhor, 2012 the Indian construction industry is considered as of the largest construction industry in the world. It can be also stated that the time of 1960 to 1970 is considered as an important phase in terms of the development of the entire industry. During this particular period, the government of India played a vital role to boost the entire industry. At this period, the majority of the construction works were executed by different state-owned enterprises, which were also supported by various government departments as well. As a result, during the first five-year plan, the construction industry of the civil works almost contributed 50 percent of the entire capital outlays. As of now, it is observed that the Indian construction industry is almost employing 33 million people. As a result, it can be stated that there is a huge number of people associated with this particular domain. Another fact, which should be highlighted, is that there are other industries, which are highly associated with the construction industries as well. These industries are skilled enhancement and technology, steel industry, and cement industry as well. As a result, from this aspect, it can be stated that the impact of the construction industry in terms of the development of the country is huge. The construction industry is also considered to be an important aspect as it allows many investment options and scopes within the country. These sorts of investments help in terms of increasing the economic growth of the country. Hence, as of now, the government of India has implemented several strategies to boost the growth rate of the construction industry.

III. RESEARCH METHODOLOGY

Problem Statement

What are different causes of delay in construction of residential building project and how it can be minimized using Genetic Algorithm based optimization technique.

Many Residential structure projects have handled various difficulties and interruption of time is one of the main difficulties. The delay in disagreement reimbursement has multiple possessions such as it will give disadvantageous to the link among owner and worker. Moreover, it will also contribute to the rate and phase overruns. It is usually said that the bond language is measured problematic to understand and they are consequently a main source of differences

Framework

This section of the research, the major concern is associated with the development of the methods and the germane processes for the research that can help the researcher to complete the research study. In this chapter, the various process of the research philosophy, paradigm, approach, and designs have been discussed with proper justification and arguments. Based on the literature findings the researcher has selected the parameters of the research that provide support for the consideration of the methods has been followed by another researcher. Moreover, throughout the discussion, a proper justification for the selection of the appropriate research strategies has been mentioned and has been thoroughly supported by the researcher and the flow chart of the project work.

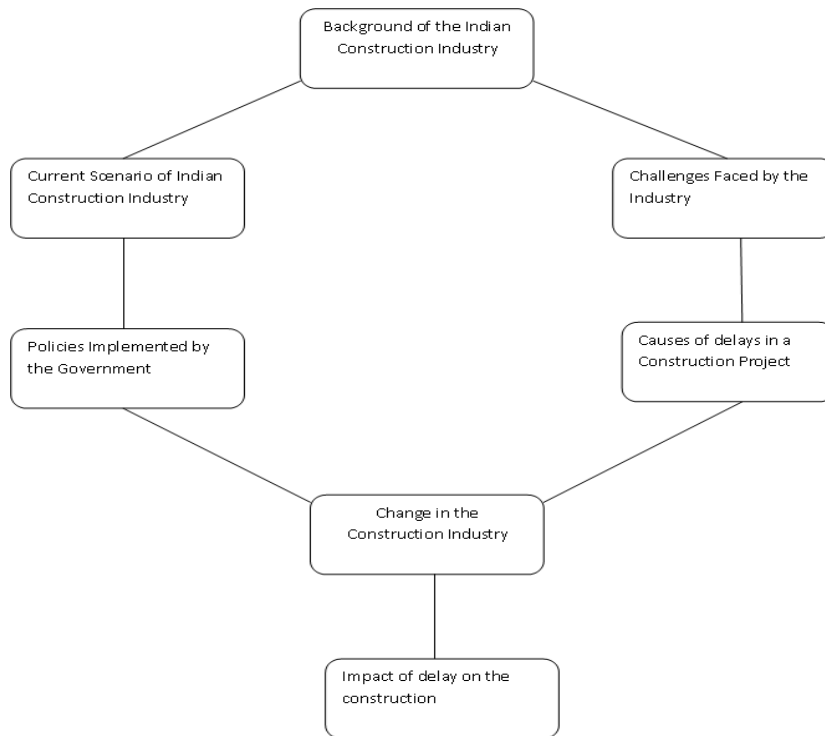


Figure 1 : Conceptual Analysis Framework

The research methodology is a description of how the objectives can be realized. The data collection can be found through qualitative and quantitative methods. The data collection through these methods will be analyzed and the results will be presented. In this study, a questionnaire was developed to assess the perceptions of consultants and contractors on the relative importance of causes and effects of delays in construction industry in Skudai, Johor. The questionnaire was divided into three parts. The first part requested background information about the respondents. The second part of the questionnaire focused on causes of construction delay. The respondents were asked to indicate their response category on 32 well-organized construction delay factors and some other additional causes from the literature review that is suitable. This study is based on traditional contract only. These causes were categorized into the following eight major groups:

- 1. Client related factors:** finance and payments of completed work, owner interference, slow decision making, unrealistic contract duration and requirements imposed and permits from municipality.
- 2. Contractor related factors:** sub-contractors, site management, construction methods, improper planning, mistakes during construction stage, inadequate contractor experience, financing by contractor during construction and mistakes in preliminary stage (soil investigation).
- 3. Consultant related factors:** contract management, preparation and approval of drawings, quality assurance and waiting time for approval of test and inspection.
- 4. Material related factors:** quality of material and shortage in material.
- 5. Labour and equipment related factors:**labour supply, labour productivity and equipment availability and failure.
- 6. Contract related causes:** change orders and mistakes and discrepancies in contract document.
- 7. Contract relationship related causes:** major disputes and negotiations, inappropriate overall organizational structure linking to the project and lack of communication between the parties.
- 8. External factors:** weather condition, regulatory changes, problems with neighbors, unforeseen site condition and accidents during construction.

This part of the questionnaire focused on effects of construction delay in construction industry. The six effects of construction delay identified were: times overrun cost overrun, dispute, arbitration, litigation and total abandonment.

Site Survey and Data Collection

The collected responses and the findings of the case studies have been arranged by the researcher. As the majority of the research findings is associated with descriptive findings from the respondents it has helped the researcher to arrange the factors according to findings from the description by the respondents. After the development of the rankings of the causes that results in the delay of the construction process has helped the researcher to analyze the impact of the delay in the construction industry. Proper analysis performance is associated with the appropriate connection of the findings with the understanding of the concept developed in the literature review section.

Case Study-1: VTP Urban Next:

The extension of the VTP Urban Next was initiated in the year 2008 by the Nikaya Group. It was a big project developed by the Nikaya Group, due to many factors, the construction was delayed resulting in huge loss of the local people and also of the management

- **Name of Project : VTP Urban Next (By NIKAYA Group)**
- **Side Margins :** Front Margin 20M, Rear Margin 20M.
- **No. of Stories :** G+11
- **No. of Flats :** 462 Flats and 80 Shops
- **Area of Flat (2BHK or 3BHK) :** 820 and 1100 Sq. Ft.
- **Location-Plot No. Survey No. :**
- **Software used at site :** MSP etc
- **No. of Buildings :** in Project (A1,A2,A3,B1,B2,B3,C1,C2)
- **Management team :**
Site Engineer: Mr. RohitWaghire
Supervisor :Mr. Harish Pawar
- **Organizer :** Mr. Nikhil Mudani
- **Design:** Mr. JW Associates
- **Planner :** Mr. Pratik Patil

Case Study-2: COLORI Phase-2

The SaiKrushi Construction is the construction company which is establish in 2001 in Pune, They have provide some quality projects in Pune city. The COLORI phase-2 is one of the best example of those projects:

- **Name of Project : COLORI Phase-2 (Amit Enterprises)**
- **Side Margins :** Front Margin 9M, Rear Margin 12M.
- **No. of Stories :** G+12
- **No. of Flats :** 288 Flats and 12 Shops
- **Area of Flat (1BHK or 2BHK) :** 520 and 840 Sq. Ft.
- **Location-Plot No. Survey No. : Undari Pune 411 060**
- **Software used at site :** MSP etc
- **No. of Buildings :** in Project (I,H)
- **Management team :**
Site Engineer: Mr. S. B. Khade
Supervisor :Mr. Esak Khan
- **Organizer :** Mr. Kishor Pate
- **Design:** Mr. JW Associates
- **Planner :** Mr. MohitPatil



Case Study-3: SuvidhaNisarga

The SuvidhaNisargais one of the most popular projects in the Pune. It was develop by AB Developers in Pune. Nevertheless, due to the delay in the construction that is caused due to many local problems and now the scheduled time of completion is estimated to be in December 2018.

- **Name of Project** : SuvidhaNisarga
- **Side Margins** : Front Margin 3M, Rear Margin 3M.
- **No. of Stories** : G+5
- **No. of Flats** : 36 Flats
- **Area of Flat** (1BHK or 2BHK) : 610 and 870 Sq. Ft.
- **Location-Plot No. Survey No.** : 624/11
- **Software used at site** : MSP
- **No. of Labour** : Given in Table 6.2
- **Overall cost of Project** : 5,25,91,543INR
- **Management team** :
Site Engineer: Mr. AsifNandihal
Supervisor :Mr. Raut
- **Plan** : Appendix 2
- **Organiser:** VitthalSonavane
- **Design:** Mr. SachinPeshave
- **Planner** : Peshave Associates

Results and Discussion

1 Data Analysis

The data analysis is determined to establish the relative importance of various factors that contribute to causes, effects, and minimization if construction delays. Analysis of data consists of the following:

- 1) Calculating the weight using fitness function
- 2) Ranking of factors in each category based on the Fitness function of GA

$$\text{Fitness (w)} = W / (A + N)$$

Where, Fitness, illustrated as W = weighting given to each factor by the respondents (ranging from 1 to 5), while A = highest weight (i.e. 5) and N = total number of respondents.

Where W is weighting given to each factor by the respondents (ranging from 1 to 5), A is the highest weight (in this case is 5) and N is the total number of respondents. The input value is range from 0 to 1 which the higher the value of fitness, the more important was the cause and effect of delays. The fitness was used to rank the different causes. The fitness is then being classified based on the fitness classification table as shows in Table 1. The discussion will be made when the fitness was classified as most preferred causes and effects of delay only.



Table 1 : The ranking of causes of delay based on consultant and contractor’s view

Causes of Delays		Consultant		Contractor	
		Fitness	Rank	Fitness	Rank
Client Related Factor	Finance and payments of completed work.	0.676	14	0.713	10
	Owner interference.	0.781	6	0.783	3
	Slow decision making.	0.648	21	0.609	25
	Unrealistic contract duration and requirements imposed.	0.610	27	0.722	9
	Obtaining permits from municipality.	0.629	25	0.583	19
Consultant Related Factor	Contract management	0.590	29	0.661	26
	Preparation and approval of drawings.	0.600	28	0.730	17
	Quality assurance.	0.638	23	0.661	6
	Waiting time for approval of drawings.	0.657	17	0.904	17
Contractor Related Factor	Sub-contractor.	0.876	1	0.852	1
	Site management.	0.829	2	0.635	2
	Construction methods.	0.781	6	0.617	20
	Preparation and approval of drawings.	0.829	2	0.5390.539	23
	Mistakes during construction stage.	0.829	2	0.670	30
	Inadequate contractor experience.	0.829	2	0.678	30
	Mistakes in preliminary stage (soil investigation).	0.648	21	0.645	16
	Financing by contractor during construction.	0.781	6	0.651	15
Material Factor	Quality in material.	0.752	10	0.557	27
	Shortage in material.	0.714	12	0.757	5
Labour and Equipment Related Factor	Labour supply.	0.762	9	0.730	6
	Labour productivity.	0.743	11	0.696	13
	Equipment availability and failure	0.667	16	0.713	6
Contract Related Factor	Change orders.	0.695	13	0.617	23
	Mistakes and discrepancies in contract document	0.638	23	0.630	6
Contract	Major disputes and negotiations.	0.657	17	0.704	12



Relationship Related Factor	Inappropriate overall organisation structure linking to the project.	0.619	26	0.548	28
	Lack of communication between parties.	0.657	17	0.696	13
External factor	Weather condition.	0.654	14	0.783	3
	Regulatory changes	0.669	30	0.635	20
	Problem with neighbors.	0.702	32	0.452	32
	Unforeseen site condition	0.645	17	0.548	28
	Accidents during construction.	0.614	31	0.635	20

This is interesting to compare the causes as perceived by consultants and contractors. Most often, one party were blaming the other. Two of the top causes perceived common between consultants and contractors are: sub-contractor and site management. The consultants blaming contractor’s improper planning, contractor’s mistakes and contractor’s experience as the important causes of delay.

Table 2 :summarize the factor according to the category that perceived by consultants and contractors.

Category	Consultant		Contractor		Overall	
	Fitness	Rank	Fitness	Rank	Fitness	Rank
Client Related Factors	0.669	4	0.694	3	0.682	4
Consultant Related Factors	0.621	7	0.659	5	0.641	7
Contractor Related Factors	0.805	1	0.709	2	0.755	3
Material Related Factors	0.733	2	0.657	6	0.693	2
Labour and Equipment Related Factors	0.724	3	0.713	1	0.718	1
Contract Related Factors	0.667	5	0.674	4	0.670	5
Contract Relationship Related Factors	0.644	6	0.649	7	0.647	6
External Factors	0.604	8	0.610	8	0.607	8

Contractor related factor (Fitness=0.805) is the most preferred causes as perceived by consultant that need to be considered in construction delay. From the views of contractors, there are no factors that can be classified as most preferred factors of delays in construction industry based on this study.

Graph Analysis of with Delay factors

After the overall analysis of collected survey using GA based method, we find each factor weight that can be assign descending order to show the impact. The below graphs show the each factor affection on delay

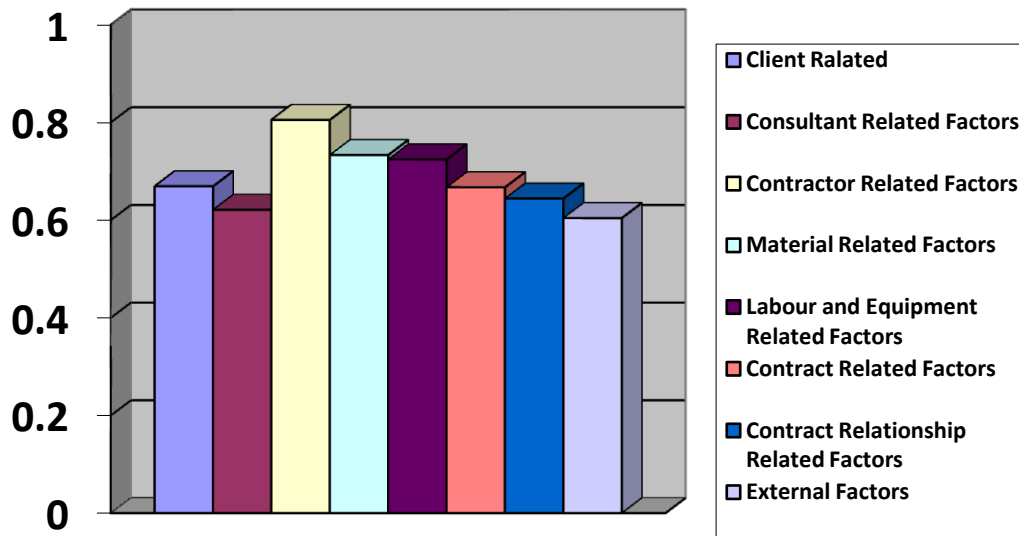


Figure 2 : Each Factor ranking using GA

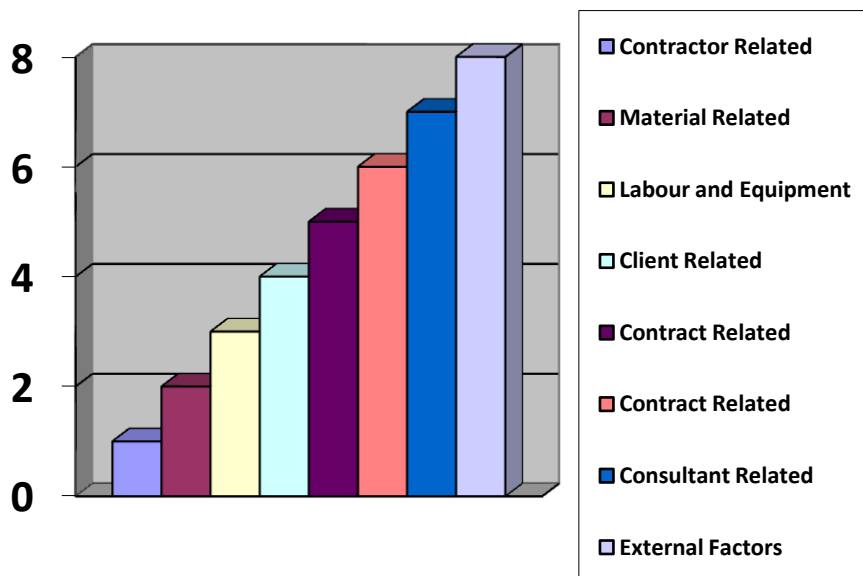


Figure 3: Each Factor ranking using GA

IV.CONCLUSION

This work presents a source controlled project schedule as per the site conditions. For source embarrassed breakdown resource leveling is done. The resource type for this project is considered manpower (labor) only. The mission plan increases day by day cost due to sudden requirement of labor or any unavoidable circumstances thus, it has an impact on the overall cost of the mission. Duration is increased for decline in source constraints. The proposed investigation shows the how different factors can affect on delay in construction. The Table 1 and Table 2 shows the analysis with all ranked parameters which is generated by genetic algorithm method. The survey also focus weight base ranking for affecting the delay. The future enhancement for this work applies same approach with different seismic can zones and validate the result with real time construction schedules.



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