



CRITICAL ANALYSIS OF CAUSES OF DELAY IN RESIDENTIAL CONSTRUCTION PROJECTS IN INDIA

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ABSTRACT

Construction industry is one of the significant contributors to the economic growth and development of India. Two major challenges are limiting the performance of the construction industry in India, which are poor cost and schedule performance of the construction projects. Therefore, the aim of this study is to fill an important knowledge gap by identifying the various attributes for construction project delay, using the residential building projects as a starting point. Feedback from a survey administered to the contractors and consultants was analysed using Relative Importance Index (RII). Results showed that shortage of materials on site; unforeseen ground conditions; poor procurement planning; problems to access the site; rework; weather conditions; inadequate modern equipment; skilled workforce; and equipment failure are ranked by the contractors and consultants as the main causes of project delays in India. Construction frontline players are recommended to put their efforts on the identified key factors in relation to their magnitudes of influence. By doing so, the causes of project delays in the India's construction and real estate sector could be significantly reduced or controlled, which will ultimately lead to the on-time project completion.

Key words: Project delays, Construction, India, Residential projects.

Cite this Article: Subhav Singh, Anju Bala, Saurav Dixit and Deekshant Varshne, Critical Analysis of Causes of Delay in Residential Construction Projects in India. *International Journal of Civil Engineering and Technology*, 9(1), 2018, pp. 330-345. <http://www.iaeme.com/IJCIET/issues.asp?JType=IJCIET&VType=9&IType=1>

1. INTRODUCTION

Indian Construction Industry has been playing a vital role for the development and economic growth of the country. A bulk of infrastructural, residential, commercial and institutional projects are in the pipeline to be transformed into reality in few years. Construction Industry incorporated a large number of working groups, teams, and stakeholders working together, involving huge amount of capital, and thus making it a giant segment contributing an appreciable portion to GDP of India. According to “makeinindia.com”, 10% of India’s GDP is based on construction activity. After agriculture, construction industry is the second largest contributor to economic activity. Construction sector allows highest inflow of FDI making it more actionable.

Indian construction industry consists of 200 firms in corporate sector and provide employment to more than 35 million people. In financial year 2014, Indian construction Industry was valued at approximately USD 157 billion. Government of India has proposed plan for development of 500 cities which represents growing scenario of this industry in India. However, construction industry is growing for the last few years but there are certain issues which are attached to it and making it one of the most unorganized sector. Any housing project would cost a huge amount of money for a customer and he is expecting to get his house as promised, but because of lack of commitment, projects are not delivered as promised. Delay is one of the biggest problem in front of Indian Construction Industry. In 2013, more than 55% of projects were experiencing time overrun. Reasons for late delivery includes shortage of skilled labour, Changes in design, rework due to errors, inflation, lack of planning etc. This kind of behaviour of industry would have a serious impact on projects under development or in the pipeline.

A lot of studies have been done all around the world for analysing the factors which affect the delivery of projects. But these factors may vary from place to place. So, the purpose of this project is to identify the project management factors, causing time overrun and analyse them to overcome. Construction industry is one of the significant contributors to the economic growth and development of India (CDC, 2015). Due to its forward and backward linkages with other industries (Durdyev and Ismail, 2012), construction industry plays a very important role in providing the required infrastructure to improve the quality of life. Sustainable development of construction industry is therefore important (Enshassi and Ayyash, 2014), which has a multiplier impact on the wider economy (Durdyev and Ismail, 2016). Construction industry contributes approximately 9.1% to the GDP of India (Dixit, Pandey, Mandal, & Bansal, 2017). However, strong evidence shows the performance inconsistency of Indian construction projects and the trend is growing rapidly. Two major challenges are limiting the performance of the construction industry in India, which are poor cost and schedule performance of the construction projects (CDC, 2015).

In Northern India, the majority of real estate construction projects face the problem of time overrun, which signifies delays in construction projects (Asim, Shumank and Aqeel, 2017). Delays are a common phenomenon regardless of whether the project is simple or complex. Kazaz et al. (2012) analyzed the reasons for construction delays and studied their impacts on the time frame. In order to mitigate the impacts of delays on the productivity and project performance it is necessary to strategically plan the project (Dixit, Mandal, Sawhney, & Singh, 2017b) The advantages of pre-project arrangement incorporate expanded benefit, lessened hazard, and superior quality (Barker et al. 2004; González et al. 2008; Hanna and Skiffington 2010; Asim, Deep, and Aqeel, 2017). Exhaustive scheduling influences to a greater extent the productivity during initiation, design and development stages (Chang et al., 2010; Yang and Wei, 2010; Deep, Singh, and Aqeel, 2016). This finding is supported by

Thomas and Ellis (2007), who utilized straightforward pre-extend arrangement strategies to diminish preparatory development length by up to 30%. Hanna and Skiffington (2010) argued that expanded construction arrangement enables the temporary worker to be more proactive than receptive with respect to basic elements that influence a venture. As per Gibson et al. (2006), strategic planning of project could lead to enhanced project result, more prominent client fulfilment, and decreased venture cost and term. Therefore, distinguishing and testing for noteworthy contrasts in the effects of the basic achievement figures with respect to time, cost, and quality are crucial in managing these elements in pre-extend arrangement as an approach to secure the best project result. In development industry, deferral could be characterized as the time overrun beyond the contract date (Assaf and Al-Hejji, 2006)(Dixit, Mandal, Sawhney, & Singh, 2017a).

Along with cost and quality, project schedule is considered to be the most significant aspect of the construction management life cycle and as one of the main drivers of the project success. Notwithstanding its proven significance, most of the construction projects (both in developing and developed countries) faced schedule delays, which makes it a chronic problem in global manner (Kaliba *et al.* 2009). Similarly, due to the poor schedule performance management, the construction projects in India are also experiencing project delays, which have to be controlled, as it will lead to a poor quality of work due to hurry (Kikwasi, 2012). Delay is defined as a time overrun beyond the project completion date agreed by the parties (Assaf and Al-Hejji, 2006). Delay may also be defined as act or event, which extends required time to deliver work of the contract, manifests itself as additional days of work (Zack, 2003). Construction project delay has been a research topic for decades and several studies have investigated causes of delays in other countries (Ogunlana *et al.* 1996; Assaf and Al-Hejji, 2006; Haseeb *et al.* 2011;

Doloi *et al.* 2012). However, most of those studies are area specific. Therefore, applicability of such research in the construction context of India still remains unexplored, which limits the resources of the industry operators to addressing the myriads of causes of delays presented in the literature. The identification of the fewest number of causes of project delays is of importance; this way, the frontline players can focus their efforts and available resources to addressing the most affective causes for optimum and time-effective results. The aim of this study is to fill an important knowledge gap by identifying the various attributes for construction project delay and it will be limited to residential building projects in India. The remainder of this research paper is structured as follows. The paper starts with the review of the previous studies that have been undertaken in other countries, continues with the methodology adopted in this research, presents the research findings after application of statistical methods and consequently offers some conclusions and recommendations geared toward controlling and reducing the delays in residential projects in India.

2. LITERATURE REVIEW

Delay in construction projects has been attracting attention of the researchers for decades. There are two types of researchers conducted in this area. The first one relates to factors that cause construction project delays, while the second one consists of analysis of reported project delays. However, in their studies conducted for the specific locations, Iyer and Jha (2005), Sambasivan and Soon (2007) and Abd El-Razek *et al.* (2008) reported the complexity of the delay analysis. Therefore, literature focusing upon project delay factors found to be relevant to this research is reviewed below.

2.1. Causes of Delays

Scientists have analyzed many reasons for postponement in the development business. Table 1 summarizes several reviews conducted from 1971 to 1994.

Table 1 Outline of Past Investigation of the Origin of Delays in Construction Projects

Researcher	Country	Critical postpone variables
Baldwin et al. (1971)	United States	Meteorological changes, deficiencies of manual drive supply, subcontracting framework
Arditi et al. (1985)	Turkey	Delays in instalments to temporary workers, deficiencies of work supply, poor workmanship, changes in requests
Assaf et al. (1995)	Saudi Arabia	Inability to pay for finished works, poor contract administration
Okpala and Aniekwu (1998)	Nigeria	Delays in instalments by organizations to temporary workers
Dlakwa and Culpin, 1990	Nigeria	Increases in the extent of work, harsh climate, inadequate resources
Semple et al. (1994)	Canada	

Sambasivan and Soon (2007) identify and evaluate the most significant causes of project delay in Malaysian construction industry, which are improper planning, poor site management, inadequate experience of the contractor, inadequate finance of the client and payments for completed work, problems related to subcontractors, material shortage, labour supply, availability and failure of equipment, lack of communication between parties and mistakes during the construction stage.

Al-Kharashi and Skitmore (2009) identify leading causes of construction project delay in Saudi Arabia by conducting a questionnaire survey administered to contractors, consultants and clients. They conclude that the most two significant causes of project delay are lack of finance to complete the work by the client and delay in progress payments by the owner.

Haseeb *et al.* (2011) conduct a research on the causes of delay in large construction projects in Pakistan, where the following factors are reported to be the most influential: natural disaster; financial and payment problems; improper planning; poor site management; insufficient experience; shortage of materials and equipment. Dolo *et al.* (2012) report the factors affecting project delays in Indian construction projects by surveying construction professionals in India. After the factor analysis, the most influential factors of project delay were identified as follows: lack of commitment; inefficient site management; poor site coordination; improper planning; lack of clarity in project scope; lack of communication; and substandard contract.

Based on the 5424 scheduled activities, Lindhard and Wandhal (2014) investigate the principal causes of project delay in Denmark construction projects through the Last Planner System theory. The most frequent causes of project delay are found to be connecting work, change in work plans, workforce, external conditions, and material and construction design. Santoso and Soeng (2016) have conducted a research on the causes and effects of delay in road construction projects in India. Based on the importance index of the factors rated by the contractors, consultants and clients, the top ten factors found to be related to the contractor and project. In addition, rain and flood factors were also found to be significantly influencing on the main objectives of construction projects, which are time, cost and quality. Thus, a literature review as depicted in Table 1 has been carried out as the basis for the efforts to identify the main causes of delay in construction projects.

Based on the review of relevant literature, it can be seen that several studies have identified and evaluated causes of project delay in other countries (Sambasivan and Soon 2007; Haseeb *et al.* 2011; Doloi *et al.* 2012; Lindhard and Wandhal, 2014). The only study (Santoso and Soeng 2016) has identified causes of project delay in India, which has analysed the delay factors in road construction projects. However, the research findings in other countries and in different project types may not be completely applicable to the nature and scope of this research, as the socio-cultural, regulatory, legislative environment and project-specific issues may vary from country to country and from project to project (Mbachu, 2011). Therefore, this study aims to fill an important knowledge gap by identifying and evaluating the causes of delay in residential projects in India, this way, the frontline construction players can focus their efforts to addressing the most affective factors for optimum and time-effective results.

3. RESEARCH METHODOLOGY

This study adopts a questionnaire survey technique to investigate the main causes of project delay in construction industry of India. There are historically proven two main reasons that are make this method difficult: being highly labour intensive on the part of respondents and particularly on the part of the researcher and being difficult to design, which requires many amendments before an acceptable questionnaire is produced (Fellows and Liu, 2008). However, even there are some consequences (such as low response rate), this method is selected as an appropriate one because it helps to gather more information for relatively cheap cost administration by post or email/web to respondents. The mode of administration of the questionnaire to the respondents is very crucial to avoid low response rate, notably for postal questionnaires, which can expect a 25 – 35 percent useable response rate. Therefore, this study administered questionnaire surveys using web domain (Survey Monkey), which allows large number of participants in a wider geography or organization coverage (Durdyev and Mbachu, 2011). Prior to the distribution of questionnaire, a small group of respondents in the pilot survey is questioned before the actual questionnaire is administered. A pilot survey was conducted with a convenience sample of 2 contractors and 2 project managers that were willing to devote quality time for in-depth interviews. This helped to improve the quality of the questionnaire design and its appeal for optimized response rate. The open-ended sections of the questionnaire served to explore further constructs which were not included in the subsets of variables for rating.

However, even the pilot survey determines the data reliability or relevancy to the industry, it is mandatory to analyse the reliability of the data using the Cronbach's alpha method based on internal consistency (Tavakol and Dennick, 2011). The following equation helps to calculate the Cronbach's alpha:

4. STATEMENT OF PROBLEM

Most of the construction projects in India get delayed because of one reason or other. This causes time overrun, cost overrun, and customer dissatisfaction and creates dispute between owner & contractor. A lot of incomplete projects are held as inventory due to such problems. Construction industry has a great hand for economic growth of country but the product has not been delivered as it should be. It has an adverse impact on FDI also, due to such image of Indian construction industry.

5. OBJECTIVES

- To find out construction-phase related factors due to which a construction project delays in delivery.
- Analyse and prioritise the construction-factors.
- To give recommendations to improve the situation.

To accomplish the objectives of project, first step is to read literature and visualize the scale of problem in NCR and accordingly find out the possible reasons for delay. Once certain factors are identified from literature, then a questionnaire would be formed using identified factors. A Scale type questionnaire would be prepared in which the respondent would have to just grade that particular factor in a scale of 1 to 5. Simultaneously interviews would be conducted with industry professionals to find out more construction factors which are important to put in questionnaire. The questionnaire would be distributed among key participants of project and after receipt, their answers would be analysed. On the basis of final score attained by each factor, these factors would be prioritised and a list of top ten „construction factors affecting project delivery“ would be formed. Ultimately, recommendation would be given according to the priority of factors. If we talk about the total number of homes or apartments in NCR which have to be delivered to buyers by this year i.e., 2015, only 28% of 6.45 lakh homes are delivered till now. Other apartments are delayed by two to four years. According to PropEquity, the average delay in possession is 29 to 30 months in Ghaziabad and Noida respectively with Gurgaon at 34 months and Faridabad way behind at 44 months (“Over 25 percent housing projects delayed pan-India; NCR worst hit: JLL India - timesofindia-economic times,” n.d.). Consequence of such problem is faced by buyers who are paying rent of their rented homes and EMIs for new ones they bought for a long time. In NCR, Noida is most affected by this problem where 3.2 lakh apartments of 3.6 lakh apartments are delayed by up to three years.

According to the above figure, delivery to committed ratio is very high in North India as compared to South India. In Noida and Greater Noida, the problem of late delivery is highest. In the western region, Pune and Mumbai have shown a much better performance in terms of project completion. These cities could deliver more than 40 percent of the committed supply of 2013 as per scheduled delivery (“Over 25 percent housing projects delayed pan-India; NCR worst hit: JLL India - timesofindia-economic times,” n.d.). There are various studies and theories regarding types of factors causing delay in construction i.e., project management factors, site factors, planning factors, procurement related factors, process-related factors, technical issues etc.

6. MEASUREMENT OF PROGRESS OF WORK

Project performance has a great impact on delivery of a project. Continuous monitoring of work is required to ascertain the planned progress of work. Recording of data is very crucial in completing a project timely. There are three factors which are used to measure the progress of work of any project, i.e., Time, Cost and Quality. However, there are more number of Key Performance Indicators (KPI) which are used to measure the progress of work in a construction project (Samir, Shaban, Engineering, & Enshassi, 2008)

- Productivity
- Client satisfaction
- Community satisfaction
- Health and safety
- Environment

A contractor faces enough number of aspects on daily basis which hampered the progress of work on site. Every day certain number of activities are planned to be completed and for the same, sufficient number of resources are also allocated to those activities. But due to certain problems, planned amount of work could not executed actually, it may be due to equipment failure, shortage of skilled labour, bad weather, slow decision making, errors in execution, quality issues and so on. Quality of management during construction implies the various efforts put into the construction stage of the project, such as analysis of construction methods and resource; work sequencing to adhere to and maintain workflow, and monitoring and updating of plans to appropriately reflect work status (Aiyetan & Smallwood, n.d.). From literature review following construction-factors are found to be significant, affecting project delivery:

Factors	Description
F1	Inaccurate soil investigation report
F2	Unforeseen ground conditions
F3	Poor procurement planning
F4	Problems to access at site
F5	Rework due to error in execution
F6	Extreme weather conditions
F7	Inadequate modern equipment
F8	Lack of skilled operators for specific equipment's
F9	Equipment failure
F10	Shortage of material at site
F11	Site accidents due to negligence
F12	Labour Strike
F13	Delay in approval of shop drawings
F14	Delay in running bill payments to the contractor
F15	Defective material provided by supplier
F16	Improper storage of material leading to damage
F17	Poor site management and supervision
F18	Poor coordination among parties
F19	Frequent change of sub-contractors
F20	Lack of control over subcontractor
F21	Poor labour productivity
F22	Inadequate experience of contractor
F23	Change in material prices
F24	Use of obsolete construction method
F25	Delay in finalization of rates for extra items
F26	Delay in handing over of site

7. CLASSIFICATION OF FACTORS IN SUB-CATEGORIES

All the above-given factors are encountered during construction stage of project and if planned properly, are controllable. These factors give a broader picture concerning delay of a project as various factors are enlisted here as a mix. So, to understand this scenario all factors are analyzed to put them in their respective slot. In order to visualize the situation more clearly, these factors are further categorized in seven verticals, as shown below:

Sr. No	Category	Name of factor			
1	Site-related	Problems to access at site Site accidents due to negligence Poor site management and supervision			
	Equipment related	Inadequate modern equipment Equipment failure			
3	Management related	Poor procurement planning Delay in approval of shop drawings Delay in running bill payments to the contractor Poor coordination among parties Frequent change of sub-contractors Lack of control over subcontractor			
		Construction method & errors related	Inadequate experience of contractor Delay in finalization of rates for extra items Delay in handing over of site Inaccurate soil investigation report Rework due to error in execution Use of obsolete construction method Shortage of material at site		
			5	Material related	Defective material provided by supplier Improper storage of material leading to damage Change in material prices
					Skilled/Unskilled labour
			7	Unforeseen factors	

Out of all these categories, management related category consists of more number of factors and can be checked by the person-in-charge himself/herself by required degree of planning. If it is analysed critically, there is one major reason of all management related issues i.e., Communication gap among teams. Due to restricted flow of information, various teams cannot perform efficiently to achieve common set of goals.

8. DATA COLLECTION

Data was gathered from secondary sources as well as primary sources. Data collected through questionnaire and interviews is primary data, while the factors causing delay were identified with the help of literature which is secondary source of information. Various reports, publications and through internet research, 26 factors were identified for survey. Both primary and secondary methods have advantages and disadvantages. The advantages of primary data are that it is recent and is aligned along the intended survey but it has disadvantage of being expensive. However, secondary data is easy to get and is relatively cheap but may be out of date. This raw data was analysed using quantitative approach. With the help of literature, various possible factors are identified. In addition, various other factors are also added as recommended by local experts. Initially, all factors causing delay to a residential project are identified and then they were sorted out to get only construction-related factors. Various studies and reports were studied to get right factors which are applicable to this study. Total 26 factors are selected at last. All these factors are arranged in a sequence according to the work done during construction phase and a questionnaire is formed.

Questionnaire

A good questionnaire constitutes of three important facts that makes it more effective for getting response and then analysis, i.e.

- Introduction: To define the objectives clearly
- Instructions: To make questionnaire easy to understand
- User-friendly: To avoid any ambiguity

Keeping in mind all the necessary components of questionnaire finally, a Questionnaire is formed using Likert scale in which each construction factor is given with a scale from 1 to 5. Most frequent happening factors at site correspond to 5 (very high effect) whereas the least frequent one would correspond to 1 (very little effect).

1-Strongly disagree

2-Disagree

3-Neither agree nor disagree

4-Agree

5-Strongly agree

The value assigned to a Likert item has no objective numerical basis, either in terms of measure theory or scale and thus the value assigned to each Likert item is simply determined by the researcher designing the survey, who makes the decision based on a desired level of detail (Keane & Caletka, 2008). A good Likert scale will present symmetry of categories about a midpoint with clearly defined linguistic qualifiers (Keane & Caletka, 2008).

Relative Importance Index Technique

Kometa et al. used the Relative Importance Index method to determine the relative importance of the various causes and effects of delays (Desai & Bhatt, 2013). Relative importance index (RII) is used here to determine the ranking of factors causing delay to a project as per contractor's or developer's view. Relative Importance Index is computed as (Dadzie, n.d.):

$$R_{ii} = \frac{\sum_{r=1}^5 r \cdot n_r}{5N} \quad (1)$$

r is the rating on a Likert scale (1-5) as for the impact on construction efficiency for a specific element influencing construction profitability, n_r is the number of respondents providing a specific Likert scale rating r, N is the aggregate number of respondents to a specific question (Naoum, 1998).

These rankings made it possible to visualise which factor is more significant to cause delay among others. There are 26 factors in this survey pertaining to different categories. The questionnaire was sent to 60 people managing the construction projects. Out of these 23 responses were received. But the responses received are reliable and authentic. So, analysis is done using 23 responses and Relative Importance Index is found out on the basis of above-given formula. The ranking of factors along with their RII is given below in the table in ascending order i.e., factor with highest RII is top ranked (most significant) and factor with lowest RII is last rank (least significant):

Poor site management and supervision" is one of the most important factor which causes delay, according to the responses received as it is evident from its rank-1. The sole problem responsible for delay is Poor site management. It may be due to lack of required skills of site

managing professional. Second site related problem is „accident due to negligence“ which has been ranked 13th by respondents. Reason of accidents is improper measures for safety at site. It may be in terms of lack of safety equipment’s for labour or lack of training due to which such incidents occur. Accidents put the progress of work on halt and dilute the reputation of organization.

Problems to access at site“ has got 23rd rank according to RII. It seems that there is not much problem regarding access at site.

Factors	RII	Rank
Poor site management & Supervision	0.878	1
Delay in running bill payments to contractor	0.73	2
Delay in handing over of site	0.722	3
Poor labour productivity	0.713	4
Poor coordination among parties	0.704	5
Rework due to error in execution	0.687	6
Inadequate experience of contractor	0.678	7
Delay in approval of shop drawings	0.652	8
Frequent change of sub-contractors	0.643	9
Delay in finalization of rates for extra items	0.626	10

Equipment Related Factors

Equipment related factors	RII	Rank
Inadequate modern equipment	0.339	22
Equipment failure	0.357	20

Management Related Factors

Management related factors	RII	Rank
Poor procurement planning	0.461	16
Delay in approval of shop drawings	0.652	8
Delay in running bill payments to the contractor	0.730	2
Poor coordination among parties	0.704	5
Frequent change of sub-contractors	0.643	9
Lack of control over subcontractor	0.591	12
Inadequate experience of contractor	0.678	7
Delay in finalization of rates for extra items	0.626	10
Delay in handing over of site	0.722	3

Funds related problem is very common in every project due to which payment to contractor delays and thus this factor is at rank 2. In some companies, even salaries of employees get delayed. There is always some finishing work left at the time of delivery and it is not well planned to adjust the time consumed for removing snags due to which delay occurs in handing over and hence „delay in handing over of site“ is ranked on 3rd position. Poor coordination among parties“ has been ranked in 5th position. Communication between various parties is very poor as true information is not shared and just keep on extending the time limits. Experience of a contractor helps him to tackle lot of day to day hassles at site but absence of the same creates heap of problems. So „Inadequate experience of contractor“ is

ranked at 7 by respondents. Once the sub-contractor prepared shop drawings and forward further for approval then it usually consume unexpectedly much time due to un-agile nature of approval authority. „Delay in approval of shop drawings“ is at 8th position in our list.

Construction method and error related factors

Construction method and error related factors	RII	Rank
Inaccurate soil investigation report	0.348	21
Rework due to error in execution	0.687	6
Use of obsolete construction method	0.504	15

Material related factors

Material related factors	RII	Rank
Shortage of material at site	0.304	26
Defective material provided by supplier	0.313	25
Improper storage of material leading to damage	0.409	18
Change in material prices	0.609	11

Pie chart

The contribution of various categories of factors causing delay is depicted below in the form of pie chart, according to the responses received from industry:

9. FACTOR ANALYSIS

Factor analysis is a method for investigating whether a number of variables of interest are linearly related to a smaller number of unobservable factors (Tryfos, 1998). Total number of variables are 26 and these are subjected to Factor analysis with the help of SPSS (Statistical Package for the Social Sciences) tool. Descriptive analysis represents mean, standard deviation and total number of responses in different columns as given in table below:

Component	Total	Initial Eigenvalues	
		% of Variance	Cumulative %
1	6.651	25.581	25.581
2	4.931	18.967	44.548
3	2.272	8.74	53.288
4	2.065	7.943	61.23
5	1.745	6.71	67.941
6	1.409	5.42	73.36
7	1.034	3.978	77.338

Factor-1 Improper planning

Table 14 (Factor-1: Improper planning)

Items	Statement	Factor loading
F6	Extreme weather conditions	0.663
F17	Poor site management and supervision	0.671
F14	Delay in running bill payments to the contractor	0.815

Improper planning is the first factor resulting from Factor analysis. Three variables are there in this factor. First variable is „Extreme weather condition“ which is evident in NCR because of unpredictable nature of weather. But lack of planning for such weather-related instances lead to wastage of labour and material resource and thus affect the cost of project. Second variable is „Poor site management and supervision“ which is key aspect for delay of a project. Poor site management itself represents lack of skills to deliver a project timely which is again a part of planning. Payment to the contractor is a part of planning as cash flow should be maintained so that work may not halted. „Delay in running bill payments“ is third variable of this factor.

Factor-2 Poor site management

Table 15 (Factor-2: Poor site management)

Items	Statement	Factor loading
F12	Labour Strike	0.835
F7	Inadequate modern equipment	0.677
F9	Equipment failure	0.603
F10	Shortage of material at site	0.414

Second factor is *Poor site management*. First variable is „labour strike“. Any kind of distracting activity done by labour is because of poor management and poor coordination with them. „Inadequate Modern equipment“ is second variable in this factor which is the result of erratic evaluation of nature of site. Sudden „Equipment failure“ creates delay and should be managed with alternate provisions. Fourth variable i.e., „Shortage of material at site“ is due to absence of awareness of site management regarding consumption of material. Delay in delivery of material will delay the project.

Factor-3 Poor contractor management

Items	Statement	Factor loading
F5	Rework due to error in execution	0.120
F20	Lack of control over subcontractor	0.773
F22	Inadequate experience of contractor	0.484
F21	Poor labour productivity	0.350

Poor contractor management is the third factor which is significant one as whole work has to be done by contractor only. „Rework due to error in execution“ is the first variable in this factor and is due to various reasons like inability to read drawings, negligence, unskilled labour etc. Contractor management is about having good coordination among contractors and sub-contractors. „Lack of control over subcontractor“ increases complexity of work and affects quality of work. „Inadequate experience of contractor“ will decelerate the progress of work and would responsible for time overrun. If labour is not working efficiently, it is mainly due to insufficient control of contractor over them. Hence „Poor labour productivity“ is a part of poor contractor management.

Factor-4 Lack of Knowledge

Table 17 (Factor-4: Lack of knowledge)

Items	Statement	Factor loading
F16	Improper storage of material leading to damage	0.831
F23	Change in material prices	0.925
F24	Use of obsolete construction method	0.747

Lack of knowledge is the fourth-factor causing delay to a project. Due to lack of knowledge, „Improper storage of material“ is done which leads to wastage of money. With passing on years „change in material prices“ has become a huge problem. One should be aware of this escalation of pricing in order to plan accordingly. „Obsolete construction method“ if used would results into more consumption of resources which should not happen.

Factor-5 Quality related issues

Table 18 (Factor-5: Quality related issues)

Items	Statement	Factor loading
F15	Defective material provided by supplier	0.836
F25	Delay in finalization of rates for extra items	0.730

Fifth factor is *Quality related issues*. „Defective material provided by supplier“ would hamper the required specifications causing quality issues and thus would require more time to do rework. „Delay in finalization of rates for extra items“ may compel a contractor to under-perform which will result to quality issues.

Factor-6 Lack of communication

Table 19 (Factor-6: Lack of communication)

Items	Statement	Factor loading
F18	Poor coordination among parties	0.883
F13	Delay in approval of shop drawings	0.762
F19	Frequent change of sub-contractors	0.401
F11	Site accidents due to negligence	0.447

Lack of communication is the sixth factor and is very crucial for timely delivery of project. „Poor coordination among parties“ happens because of lack of communication between them. Day to day issues are not shared among various parties and creates confusion. „Delay in approval of shop drawings“ is due to lack of communication between sub-contractor and general contractor. Lack of communication leads to heap of unclear objectives which a sub-contractor may not able to achieve and results into „Frequent change of sub-contractor“. Misleading information regarding requirement of PPE is forwarded due to which „site accidents“ occur.

Factor-7 Lack of commitment**Table 20** (Factor-7: Lack of commitment)

Items	Statement	Factor loading
F26	Delay in handing over of site	0.812
F8	Lack of skilled operators for specific equipment's	0.844
F3	Poor procurement planning	0.375

Seventh factor is *Lack of commitment*. „Delay in handing over of site“ is because of lack of commitment. Labour contractor has to provide skilled operators for equipment's according to contract and if it is not done, it is due to lack of commitment. Lack of material or delay in material arrival is due to wrong planning and lack of commitment to deliver project timely.

A Fishbone diagram is used to identify and display various causes for a problem. It helps in identifying relationships between the causes and assists in better understanding of problem. With the help of Fishbone diagram (Cause and effect diagram), it is easy to analyse that which data should be collected. Fishbone diagram given above represents all the factors which are responsible for delay.

10. SUMMARY

According to RII method of analysis of factors, „Management related factors“ are more important to resolve as they contribute a significant portion of delay in a project i.e., 42%. Some of the key concerns relating to management related problems are lack of coordination among teams, delay in finalization of rates for extra items, delay in approval of shop drawings and poor procurement planning. Factor analysis shows eight significant factors responsible for delay of a project and how these factors are related to each other.

11. CONCLUSIONS

Providing accommodation to people is a big point of consideration in India these days, according to the Government of India as well as private entities. There are thousands of residential projects which are in execution phase and many are in planning phase. But delivering home to customer at the time promised is a challenge for builders in NCR due to one reason or another. The aim of this study is to identify the construction-phase related factors which delay a residential project.

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