

An Assessment of the Factors Causing Delays on Residential Construction Projects in Pune

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Abstract: Residential building construction projects in Pune construction industry are experiencing a wide spread of delays. The purpose of this study was to assess the factors causing delays and their effects on building construction projects in Pune. Thirty Two (32) project delay attributes were identified through detailed literature review. Structured interviews and questionnaire survey were conducted across stakeholders. This research categorized the causes of delay under three main groups of consultant related, contractor related and client related. The RII technique for all delay factors and group of categories was computed so as to rank the factors. The most significant factors of construction delays were identified as: (1) Shortage of materials; (2) Obtaining permit from municipality; (3) Late deliveries of materials; (4) Legal disputes; (5) Shortage of skilled labors. The study concluded that contractor related category had the highest impact (RII 0.96), followed by consultant related (RII = 0.94), then client related (RII = 0.93). Identification of the causes of potential delay factors that are likely to affect the timely delivery of projects can help to avoid extra costs through claims and disputes that arise among parties when delays are experienced.

Keywords: Delays, Relative Importance Index (RII), effects of delays.

1. Introduction

The basic source for economic development of any country like India is construction or infrastructure. Huge amount of employment is generated by construction sector. Currently India is the second fastest growing economy in the world and it is contributing 7.1 % to GDP. Very less number of project are completed within time and cost. Residential projects in Pune where 'n' numbers of projects are infamous for delays and cost overruns. Time, cost, quality and safety these are the main objectives of construction project. Several factors can contribute to delays on a project and analyzing the causes of delays which is an essential task for any potential conflicts or claims. Most delay claims are complicated and whereas many researchers emphasize the high cost and the associated risk related to litigating delay claims, few emphasize the responsibility for project delays. While the importance of Pune construction sector over the past five years has grown significantly. There is strong evidence of inconsistent performance of Pune construction projects both by international firms and local construction contractors (LCC) and the trend is growing rapidly. Projects are reportedly failing across all the key performance measures of cost, time and quality. It is therefore imperative to ascertain the key factors impacting delays in the Pune context and establishes the relationship between the critical attributes for assessing the impacts of these factors on delay. There is limited study regarding the intrinsic factors affecting all these key performance measures in the Pune context and therefore this research was necessary in an attempt to assess the factors affecting delays on residential building construction projects in terms of timely delivery. It is envisaged that the results obtained from this study could be generalized to other locations within the Pune city operating under similar conditions.

The phenomenon of delay adversely affects all the parties related to project such as client, consultant and contractor.

Extension of time which leads to extra overheads that leads to increase in the cost of project. The common results of delays are: late completion of project, increased cost, and loss of productivity, disruption of work, third party claims, disputes and abandonment of contracts. Therefore delays in construction projects give rise to dissatisfaction to all parties involved. In order to complete the project within the budgeted time and cost, causes of delay should be identified first. Once it is clear then parties can take steps to avoid delay for the next project or existing project.

2. Literature Review

A number of studies have been conducted in related with delays in construction projects for decades with scholars advancing various factors and groups of factors that contribute to causing delays. Available literature reviewed indicate categorization of the various factors in groups of up to nine (9) categories of consultant-related, contractor - related, design-related, equipment-related, externality - related, labor-related, material-related, owner-related, project-related. This study however re-clustered these factors into Three (3) broad categories of consultant-related, contractor-related and client-related.

2.1 Consultant Related Delay Factors:

The literature review was done through international journals, conference published papers, and interview with experts from the construction industry to identify factors that are responsible for delays in delivering construction projects. Several studies have identified consultant related factors to cause schedule delays. Aibinu and Odeyinka [4] found that incomplete drawings, late issuance of instructions and inadequate supervision critically impacted on consultant related group of delays. Al-Khalil and Al-Ghafly [5] found that inadequate site supervision by the consultant was the major cause of delay. Al-Kharashi and Skitmore [6]

concluded delays in approving major changes in the scope of works, inadequate experience of the consultant and late in reviewing design documents as critical. In a separate study, Arditi *et al.*, [7] concluded delays in design work and inadequate site inspection as the main causes of consultant related delays. Assaf and Hejji [8] found the consultant related delay factors as; delay in performing inspection and testing by consultant, delay in approving major changes in the scope of work by consultant, poor communication and coordination between consultant and other parties like contractor, late review and approval of design documents by consultants, conflicts between consultant and design engineer, inadequate experience of consultant. Assaf *et al.*, [9] identified design errors made by designers, changes in types and specifications during construction, insufficient communication between owner and consultant during design stage as critical.

Chan and Kumaraswamy [10] concluded delays in design information, inadequate design team experience and mistakes and discrepancies in design documents. In a separate study, El-Razek *et al.*, [11] identified that design changes during construction, changes in material types and specifications during construction and design errors made by designers contributed to delays. Faridi and El-Sayegh [12] found that slow preparation and approval of drawings, incomplete drawings, specifications and or documents and change in drawings as factors of consultant related delays. In a study analyzing factors affecting delays in Indian construction projects, concluded that lack of commitment and Architect's reluctance for change contributed to delays. Iyer and Jha [13] found that the factors of inadequate project formulation in the beginning and reluctance in timely decision by the consultant as key causes of delay. Ling and Hoi [15] identified the causative factors in terms of technical risks that included design failure, estimation error and new technology failure. Lo *et al.*, [16] found that the factor of poor site management and supervision as the main cause of consultant related delay. Mansfield *et al.*, [17] identified the problems of poor contract management, mistakes and discrepancies in contract documents and inspection and testing of completed portions of work as key causes of consultant related delays.

2.2 Contractor Related Delay Factors

Aibinu and Odeyinka [4] concluded that financial difficulties, equipment breakdown and maintenance problems, planning and scheduling problems, material and equipment shortages, slow mobilization and shortage of manpower as main contributors to this category of delay factors. Al-Khalil and Al-Ghaffly [5] identified that financing and cash flow challenges, poor project management and inadequate manpower were key considerations. Al-Kharashi and Skitmore [6] found that poor qualification of contractor's technical staff, poor site management and supervision and difficulty in financing the project were critical. Arditi *et al.*, [7] concluded that inadequate supply of materials, and contractor's financial difficulties were the main causes of delay. Assaf and Al-Hejji [8] observed the contractor related delay factors as; difficulties in financing project by contractor, conflicts in sub-contractors schedule in execution of project, rework due to errors during construction, conflicts

between contractor and other parties (consultant and owner), poor site management and supervision by contractor, poor communication and coordination by contractor with other parties, ineffective planning and scheduling of project by contractor, improper construction methods implemented by contractor, delays in sub-contractors work, inadequate contractor's work, frequent change of sub-contractors because of their inefficient work, poor qualification of the contractor's technical staff, delay in site mobilization. Assaf *et al.*, [9] observed that inadequate contractor finance, shortage of manpower, slow delivery of materials and errors committed during construction works affected delivery of the projects.

Chan and Kumaraswamy [10] concluded the factors of poor site management and supervision and improper project planning and scheduling that contribute to causes of delays. El-Razek *et al.*, [11] identified that contractor's inadequate financial resources and slow delivery of materials were the major causes of delays. Faridi and El-Sayegh [12] observed that shortage of manpower, poor site supervision and management and non-availability of materials on time as lead causes of delays under contractor related category. Numbers of studies have identified material related delay factors as one of the key dimensions in contractor related delays that has contributed significantly to causes of schedule delays in construction projects. Al-Hejji [8] found that material related delay factors as; shortage of construction materials in market, changes in material types and specifications during construction, delay in material delivery, damage of sorted material while they are needed urgently, delay in manufacturing special building materials, late procurement of materials, late in selection of finishing materials due to availability of many types in market.

Other authors examined the contribution of equipment related attributes to contractor delay factors and assessed their significance in causing schedule delays in construction projects. Chan and Kumaraswamy [10] concluded the factor of shortage of equipment and improper equipment as factors that contribute to causes of delays. Assaf and Al-Hejji [8] observed equipment breakdowns, shortage of equipment, low level of equipment-operator's skill, low productivity and efficiency of equipment, lack of high-technology mechanical equipment as causes of delays.

2.3 Client Related Delay Factors

Many studies have identified owner related delay factors to cause schedule delays. Aibinu and Odeyinka [4] observed that Clients' cash flow problems, variation orders and slow decision making were critical. Also lack of incentive for contractors for early finish and slow decisions from owners were critical. Al-Kharashi and Skitmore [5] observed that lack of finance to complete the works and slow decision making by the owner as having greatest impacts to delays. Arditi *et al.*, [7] observed that delay in payments to contractor and frequent change orders had the greatest effect. Assaf and Al-Hejji [8] observed that the owner related delay factors as; delay in progress payments by owner, delay to furnish and deliver the site to the contractor by the owner, change orders by owner during construction, late in revising and approving design documents by owner, delay in

approving shop drawings and sample materials, poor communication and coordination by owner and other parties, slowness in decision making process by owner, conflicts between joint-ownership of the project, unavailability of incentives for contractor for finishing ahead of schedule and suspension of work by owner.

Assaf *et al.*, [9] observed that intermitted stoppage of works due to cash flow challenges and delays in making progress payment to the contractor as the main causes under this category. Chan and Kumaraswamy [10] found that client initiated variations, unrealistic contract durations imposed by client and low speed of decision making as key. El-Razek *et al.*, [11] observed delays in effecting payments to contractors and slow decision making process were critical causes of delays. Faridi and El-Sayegh [12] concluded slowness in owner's decision-making process and changes in materials type and specification during construction by the owner as factors that contribute to causes of delay. Gündüz, *et al.*, [2] observed change orders, delay in site delivery and slowness in decision making as the most significant factors under this category. In a separate study, Hemanta *et al.*, [3] found that slow decision from owner and unrealistic time schedule imposed in contract as causes of delays. Iyer and Jha [13] observed that the factors of vested interest of client's representative in not getting the project completed in time, project completion date specified but not yet planned by the owner and urgency emphasized by the owner while issuing tenders as key causes under this category. Lo *et al.*, [16] found that the factor of unrealistic contract duration as the major cause of delay under the client related category. Mansfield *et al.*, [17] observed the factors of financing and payment of completed works and design changes by client as key causes of delays. Nkado [20] observed the factors of specified sequence of completion, priority on construction time, financial ability and possible changes to initial design as the major causes of delay.

3. Data Analysis

The analysis of collected responses from questionnaire was done using IBM made Statistic Package for Social Science (SPSS) software where the Cronbach's alpha reliability value and spearman's rank correlation factor were calculated. The contribution of each of the factors to overall delays was examined and the ranking of the attributes in terms of their criticality as perceived by the respondents was done by using Relative Importance Index (RII) which was computed using following equation and the results of the analysis are presented in Table no. 1

$$RII = \frac{\sum W}{A * N} \dots \dots \dots (0 \leq RII \leq 1)$$

Where:

W – is the weight given to each factor by the respondents and ranges from 1 to 4, (where “1” is “not important” and “4” is “very important”);

A – is the highest weight (i.e. 4 in this case) and;

N – is the total number of respondents.

4. Conclusion and Recommendations

Delays are inevitable; however, they can be avoided or minimized when their causes are effectively identified and analyzed. The aim of this study was to assess the delays on building construction projects in Pune. A total of 32 delay attributes were identified and categorized into three groups of consultant related delay factors, contractor related delay factors and client related delay factors. The computed RIIs provided a benchmark for ranking all the attributes and group of delays so as to inform the basis for determining the most significant and insignificant factors in the Pune context.

According to the results and findings of this study, the following recommendations can be made as ways to minimize and control delays in construction projects:

5. Consultant Related Recommendations

- Consultants should ensure that all design changes during the execution of the works are handled explicitly while not compromising the desired outcome of the final project.
- Any design errors made by consultants must be immediately rectified to avoid delays in the progress of works.
- The consultants should ensure that adequate site investigations are carried out both during feasibility study and conceptual design so as to ensure that appropriate measures are taken care of during the detailed design so as to avoid suspension of works during the construction phase to address the design challenges.
- All working drawings must be clearly drawn indicating all the dimensions and labels to scale so as to avoid ambiguity during construction.
- The consultant should ensure that there is a competent representative on the site to make quick decisions that are binding and to ensure that works that have to be measured prior to covering are done so as to facilitate preparation of interim payment certificates.
- The lead consultant should ensure that there is timely, accurate and adequate communication between all stakeholders during pre-contract, contract and post-contract period.

6. Contractor Related Recommendations

- Contractors should pay particular attention to the requirements of the assignment during the pre-contract and bidding period so as to go for works that they have competitive advantage.
- Contractors should ensure that they have enough cash flow to execute the works and desist from the practice of diverting particular project funds to non-project activities to avoid being cash-strapped during the execution of the works.
- The contractors should ensure that they have adequate experience for a required assignment, deploy competent project team and employ appropriate construction methods for the required assignment.
- The contractor should ensure proper planning and scheduling of the works and ensure effective site management and supervision of the works so as to keep watch on critical activities and strive to complete

Table 1: Relative Importance Index and Rank of Delay factors according to Consultant, Client and Contractor

Factor of delay	Consultant		Client		Contractor		Sum	Overall Rank
	RII	Rank	RII	Rank	RII	Rank		
Shortage of materials	0.92	2	0.93	1	0.96	1	2.81	1
Obtaining permit from municipality	0.94	1	0.93	3	0.89	3	2.77	2
Late deliveries of materials	0.81	5	0.93	2	0.79	5	2.52	3
Legal disputes	0.86	4	0.79	5	0.79	6	2.43	4
Shortage of skilled labour	0.89	3	0.79	4	0.68	17	2.35	5
Delay in releasing payment.	0.75	8	0.64	11	0.82	4	2.21	6
Poor design	0.78	7	0.68	10	0.75	10	2.21	7
Underestimation of time for completion by contractors	0.72	11	0.71	6	0.75	8	2.19	8
Poor site management	0.75	9	0.68	9	0.75	9	2.18	9
Poor professional management	0.61	20	0.61	15	0.93	2	2.15	10
Mistakes with soil investigations	0.72	12	0.64	12	0.71	13	2.08	11
Lack of programme of works	0.67	15	0.71	7	0.68	15	2.06	12
Poor supervision	0.72	10	0.57	18	0.75	7	2.04	13
Underestimation of cost of projects	0.78	6	0.61	13	0.61	22	1.99	14
Accidents during construction	0.67	16	0.54	24	0.75	11	1.95	15
Delay by sub-contractors	0.56	26	0.71	8	0.68	16	1.95	16
Construction methods	0.67	14	0.54	21	0.68	14	1.88	17
Foundation conditions encountered on site	0.61	23	0.54	23	0.71	12	1.86	18
Discrepancy between design specification and building code	0.64	18	0.61	17	0.61	27	1.85	19
Shortage of unskilled labour	0.64	19	0.54	25	0.68	19	1.85	20
Delay in instructions from consultants	0.61	21	0.57	20	0.64	20	1.83	21
Underestimation of complexity of projects	0.69	13	0.50	26	0.61	23	1.80	22
Breakdown of equipments	0.58	24	0.61	16	0.61	25	1.80	23
Insufficient communication between parties	0.61	22	0.54	22	0.61	26	1.75	24
Difficulty in accessing bank credit	0.53	28	0.61	14	0.61	24	1.74	25
Unskilled equipment operators	0.53	29	0.50	29	0.68	18	1.71	26
Fluctuation of prices	0.56	25	0.57	19	0.57	28	1.70	27
Client initiated variations	0.64	17	0.50	27	0.54	30	1.67	28
Necessary variations	0.56	27	0.43	30	0.57	29	1.56	29
Unfavourable site conditions	0.44	30	0.43	31	0.64	21	1.52	30
Bad weather conditions	0.33	32	0.50	28	0.32	31	1.15	31
Public holidays	0.39	31	0.39	32	0.29	32	1.07	32

projects within the specified time while meeting quality and cost requirements.

7. Client Related Recommendations

- Clients must ensure that their demand in design changes during the construction period should have no adverse effects on the critical activities so as to avoid causing delays.
- All change order demands must be evaluated to assess their impact on quality of work envisaged, scope and cost, possible claims and disruption to work so as to avoid unnecessary disputes and litigation.
- Clients should ensure that proper planning and costing of the works are made during the pre-contract period so as to avoid intermittent stoppage of works as a result of funding constraints since this not only increases the construction period but also impacts on the contractors overhead costs and costs associated with mobilization and demobilization during the period within which the works were suspended.
- Clients should ensure that interim payment certificates are paid in time within the stipulated time-frame so as not only to avoid having interest penalty clauses invoked, but also to facilitate the progress of works to ensure timely completion.

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