RESOLVING CLIENT-LINKED DELAYS IN CONSTRUCTION PROJECTS IN INDIA

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ABSTRACT

Client-linked delays are prevalent in construction projects in India. Using the survey research method and the principles of system dynamics modelling, this study examined the influence of various client-induced factors that cause delays in construction projects, and the mechanisms that have been developed to resolve the challenge of delays in construction projects in the Indian context. The findings suggest that delays in progress of payment by the owner, slowness in decision-making by the owner, change orders by the owner during construction, poor communication and coordination by the owner and other parties, lateness in revising and approving the design documents by the owner, delays in approving the shop drawings and sample materials by the owner, and delays in furnishing and delivering the site to the contractor by the owner are the major client/owner-related factors which cause delays. The mechanisms developed suggest that timely decision-making, reinforced by availability of the requisite information and effective communication, together with availability of funds and an adequate budget allocation, can ensure timely progress of payment, which essentially should be able to reduce construction delays.

Keywords: client, communication, construction, funds, system dynamics modelling

1. INTRODUCTION

The construction industry is a significant contributor to the Indian economy. It is estimated that it has accounted for about 6% to 9% of the gross domestic product (GDP) of the country in the last five years. The sector is also generating substantial employment consistently, and it is predicted that employment will grow at a rate of about 8% to 9% per year, which is expected to add about 2.5 million jobs per year. However, despite this economic potential, the construction industry is faced with the challenges of low productivity, and time and cost overruns, which range from 20–25% in building projects to 50% in other sectors, such as the power, petroleum and railway sectors (Ernst & Young, 2011; Gupta et al., 2009). More notably, delays are a major cause of concern in the majority of construction projects in India.

A number of investigations have been conducted to explore the intrinsic factors and the causes of delays; these investigations are reported in the mainstream project

management and construction management research literature (Assaf and Al-Hejji, 2006; Aiyetan and Das, 2016; Das, 2015; Doloi, Sawhney, Iyer and Rentala, 2012; Iyer and Jha, 2005). Evidence from various investigations suggests that availability of qualified professionals, quality performance, time, and cost are major challenges faced by the construction industry. Time overruns are the most significant factor that results in cost escalation. Such challenges have been cited by various stakeholders, namely clients, contractors, consultants, and designers, etc. However, client/owner-related factors are argued to be major concerns of delays, in addition to other factors linked to the contractor, the design, the equipment, project management, etc. The literature also suggests that although the client-linked causes and factors of delays have been identified, it is contended that most studies have failed to examine how the identified causes work together in a mechanism and influence the occurrence of delays (Doloi, Sawhney, Iyer and Rentala, 2012).

It is therefore argued that area-specific identification of the causes and factors of delays without an understanding of the collective influence of delays on schedule performance does not provide a convincing argument for preventing delays in the context of Indian construction projects (Doloi, Sawhney, Iyer and Rentala, 2012). This is because an understanding of the mechanisms that cause delays, and causal relationships, is pivotal to quantify schedule performance under various scenarios and to develop policy interventions to reduce delays and improve schedule performance. So, the main concern remains with the lack of understanding of the causal relationships between the factors and the mechanisms, and not foreseeing unwarranted events that cause delays. In the Indian context, it is also observed that investigations on causes of delays because of client or owner attributes are limited. Moreover, there has scarcely been any significant research conducted on the interlinkage of the various client-linked factors, which develop mechanisms that engender delays in construction. In other words, investigations relating to development of policy/strategic interventions or mechanisms based on the causal relationships between the client-induced factors, to resolve the challenge of delays in construction projects in India, are observed to be scarce.

Therefore, the objectives of the article are to examine the influence of various client-related factors causing delays in construction projects in the Indian context, and to develop mechanisms based on the causal feedback relationships between the various client-related factors influencing delays in construction projects, which could assist project stakeholders to identify the activities and events, understand the interlinkage between the variables that cause delays, and make appropriate policy interventions to resolve the challenge of delays in construction projects.

The investigation was conducted using survey research methodology and the system dynamics (SD) modelling approach. The findings suggest that delays in progress of payment by the owner, slowness in decision-making by the owner, change orders by the owner during construction, poor communication and coordination by the owner and other parties, lateness in revising and approving the design documents by the owner, delays in approving the shop drawings and sample materials by the owner, and delays in furnishing and delivering the site to the contractor by the owner are the major client/owner-related factors which cause delays. These variables are interlinked with

each other and function in causal feedback mechanisms, creating a chain of actions, which influence the occurrence of delays. Remedial mechanisms involving timely decision-making, reinforced by availability of the requisite information and effective communication, together with availability of funds and an adequate budget allocation, can ensure timely progress of payment, which essentially can reduce construction delays in construction projects in India.

2. LITERATURE REVIEW

Delays in construction can be defined as the time overruns either beyond the contract date specified in a contract or beyond the date that the parties agreed upon for delivery of a project. Generally, it is the additional days of work for completion of a project/activity or as a delayed start of an activity (Assaf and Al-Hejji, 2006; Stumpf, 2000). Since the construction process is subject to many variables and unpredictable factors, delays are found to be inevitable, and they become an integral part of the project's construction life. Even with the availability of advanced technology, and understanding of project management techniques, construction projects continue to suffer delays (Stumpf, 2000). The sources of delays are varied, and they include the performance and involvement of stakeholders, resource availability, environmental conditions, and contractual relationships, among others (Alaghbari et al., 2007; Odeh and Battaineh, 2002). Scholars such as Al-Barak (1993), Al-Momani (2000), Chan and Kumaraswamy (1997), Kaming et al. (1997), Kumaraswamy and Chan (1998), and Noulmanee et al. (1999) have studied the causes of delays in different projects, and they have found that causes of delays vary with context and project environment. Some of the most important factors responsible for time overruns and delays are design changes, poor labour productivity, inadequate planning, and resource shortages (Al-Momani, 2000; Kaming et al., 1997; Kumaraswamy and Chan, 1998). Lack of organisational support, poor health and safety, rework, extra work, external factors such as unavailability of utilities, government law and regulations, etc. also cannot be underestimated (Aiyetan and Das, 2015; Iyer et al., 2008). However, scholars have also established that client-related factors contribute significantly to project delays. For instance, Chan and Kumaraswamy (1997) found that slow decision-making by clients and client-initiated variations are the major causes of delays.

Although from the literature published over the past few decades, it is observed that there is a high degree of similarity in the delay factors across many projects, the factors associated with the construction industry in India do not necessarily follow the same pattern (Ernst & Young, 2011). In the Indian context, although some scholars have established that inadequate design and planning, coupled with scope creep, regulatory hurdles, and contractor- and consultant-related factors, are the primary reasons for time overruns in Indian construction projects, the role of owners in causing delays is considerable (Aswathi and Thomas, 2013; Doloi, Sawhney, Iyer and Rentala, 2012; KPMG and PMI, 2012; Ndekugri et al., 2007; Singh, 2010). Factors such as delays in progress of payment by the owner, delays in furnishing and delivering the site to the contractor by the owner, change orders by the owner during construction, lateness in revising and approving the design documents by the owner, delays in approving the shop drawings and sample materials by the owner, poor communication and coordination by the owner and other parties, slowness in decision-making by the owner,

unavailability of incentives for the contractor to finish ahead of schedule, and suspension of work by the owner also cause delays (Assaf and Al-Hejji, 2006; Desai and Bhatt, 2013; Doloi, Sawhne and Iyer, 2012).

However, it is seen that although many of the factors are interlinked and have cause-and-effect relationships (Assaf and Al-Hejji, 2006; Chan and Kumaraswamy, 1997; Das, 2015; Das and Emuze, 2017; Odeh and Battaineh, 2002; Frimpong et al., 2003; Manavazhi and Adhikari, 2002; Sambasivan and Soon, 2007), explicit studies relating to causal feedback relationships and their influence on construction delays are found to be limited. So, the importance of early identification of construction delays and development of a causal interlinkage between the factors, to engender delay-reducing remedies, has been stressed (Alaghbari et al., 2007; Sweis et al., 2008).

3. RESEARCH METHODOLOGY

The survey research method was employed to collect primary data from the various stakeholders in construction projects in Odisha state of India. The survey was conducted using a pretested questionnaire. The questionnaire was developed by incorporating most of the key factors under the client attributes causing delays, as observed from various sources (Aswathi and Thomas, 2013; Desai and Bhatt, 2013; Doloi, Sawhney, Iyer and Rentala, 2012; Odeh and Battaineh, 2002; Lo et al., 2006; Satyanarayana and Iyer, 1996; Semple et al., 1994), and testing and fine-tuning them through a pilot survey in the study area.

A total of 120 questionnaires were administered to various professionals and stakeholders, who were selected from 28 large and medium construction projects in Odisha state of India through a random selection process. Table 1 presents the profile of projects and respondents used for the survey. The various construction projects from which respondents were selected for the survey include building (39.2%), road (21.4%), bridge (14.28%), railway (7.14%), power plant (7.14%) and industrial complex (10.71%) projects. The respondents include project managers (16.67%), architects (10.78%), engineers and designers (13.73%), skilled technicians (8.82%), consultants (11.76%), estimators (quantity surveyors) (10.78%), contractors (12.75%), and clients/owners (12.75%), who were surveyed through the semi-structured interview method. From the survey, of the 120 questionnaires administered, 102 responses were returned, which equates to a response rate of 85%.

Table 1: Profile of respondents

Project characteristics			Characteristics of respondents			
Type of project	**Number**	**Percent**	**Respondents**	**Number**	**Percent**	**Average industry experience (range in years)**
Buildings	11	39.28	Owners/clients	13	12.75	14–22
Roads	6	21.42	Project managers	17	16.67	8–15
Bridges	4	14.29	Consultants	12	11.76	7–18
Railways	2	7.15	Architects	11	10.78	6–15
Power plants	2	7.15	Engineers	14	13.73	13–20
Industrial complexes	3	10.71	Contractors	13	12.75	12–21
Total	28	100.00	Estimators	11	10.78	5–14
			Skilled technicians	9	8.82	4–16
			Total	102	100	8.6–17.6

The respondents were asked to assess the perceived influence of the measured attributes in the form of an affirmative question, by selecting one of the projects in which they had participated. A five-point Likert scale (1 = not influential, 2 = less influential, 3 = somewhat influential, 4 = significantly influential, and 5 = most influential) was adopted to guide the participants to provide their objective responses for various degrees of influence of client-related factors on construction delays (Doloi, Sawhney, Iyer and Rentala, 2012; Gravetter and Wallnau, 2009).

A quantitative descriptive statistics analysis and a Cronbach's alpha test of the data collected were conducted to observe the reliability of the data. A Likert scale was employed to measure the relative influence of the variables in terms of a delay index (DI) (as obtained from the surveyed data) causing delays. The delay index is the mean score achieved from the responses of the respondents. Conceptual models using SD modelling principles (Forrester, 1968; Sterman, 2000), based on the systems thinking process (Von Bertalanffy, 1974), were then developed. The construction project was considered as the system, or the environment, while developing the model. The influential variables, their positive and negative influences on the related variables, and the causal relationships between them were used to develop the conceptual SD models. The causal relationships between the variables within and across the major parameters were developed based on the evidence observed from the literature, as well

as discussions conducted with and the experiences of the professionals surveyed. The causal relationships were developed using a systematic process. First, the variables of information, decisions, actions, and environment (system) were identified (Olaya, 2012). Second, the variables were connected with simple one-way causality, in terms of one-way linkages of information, decisions, and actions impacting on the environment with their influence (i.e., information assisting in making decisions (policy interventions), decisions leading to appropriate actions, and actions influencing the environment (the system)) (El Halabi et al., 2012; Olaya, 2012; Vennix, 1996). Third, once the one-way causalities were established, the feedback relationships were checked and established. Fourth, the constructed causal feedback relationships were then discussed with the professionals and experts in the field to check the validity of the causal diagrams, and relevant modifications with respect to the names of the variables, their polarity, and causal relationships, as need be, were made. Finally, modifications and amendments to the causal relationships and conceptual models and validation were made to develop the final causal feedback relationships and conceptual model. The valid causal feedback diagrams (causal loop diagrams) were then employed to develop the conceptual SD models.

4. RESULTS, CONCEPTUAL SD MODELS, AND MECHANISMS

4.1 Major client-related factors causing construction delays

Table 2 presents the client-related factors and their level of influence on construction delays. The high Cronbach's α value (0.93) shows the reliability and acceptability of the data. It is observed that the standard deviations (SDs) are also within an acceptable range, which shows that there was low variation in the responses of the respondents. So, the results are considered as acceptable and can be used for further analysis. From Table 2 it is evident that delays in progress of payment by the owner (DI=4.35), slowness in decision-making by the owner (DI=4.20), change orders by the owner during construction (DI=4.10), poor communication and coordination by the owner and other parties (DI=4.05), lateness in revising and approving the design documents by the owner (DI=3.95), delays in approving the shop drawings and sample materials by the owner (DI=3.85), and delays in furnishing and delivering the site to the contractor by the owner (DI=3.65) are the major client/owner-related factors which cause delays. Factors such as suspension of work by the owner (DI=3.20) and unavailability of incentives from the client to the contractor to finish ahead of schedule (DI=2.85) have less impact on delays in construction.

Table 2: Significance of attributes and factors influencing delays in construction

Group/ attribute	Factor	Delay index (DI) (Likert-scale mean score)	SD	Cronbach's α	Rank in the group	General rank across the groups
Client/ owner	Delays in progress of payment by the owner	4.35	0.34	0.93	1	1
	Delays in furnishing and delivering the site to the contractor by the owner	3.65	0.27		7	13
	Change orders by the owner during construction	4.10	0.32		3	5
	Lateness in revising and approving the design documents by the owner	3.95	0.33		5	7
	Delays in approving the shop drawings and sample materials by the owner	3.85	0.38		6	9
	Poor communication and coordination by the owner and other parties	4.05	0.35		4	6
	Slowness in decision-making by the owner	4.20	0.32		2	3
	Unavailability of incentives from the client to the contractor to finish ahead of schedule	2.85	0.26		9	21
	Suspension of work by the owner	3.20	0.22		8	19

4.2 Conceptual models, understanding of the causal feedback relationships responsible for client-induced delays, and possible mechanisms to reduce delays

Considering the influence of the factors as discussed above, conceptual SD models have been developed to understand the dynamic causal feedback relationships between the factors which cause delays, and to develop possible mechanisms that can assist in developing policy interventions to reduce or eliminate delays in construction. In the model, the causal feedback relationships (loops) which essentially balance or disrupt

the system (construction projects), and consequently promote delays, are identified by balancing loops (Bs). By contrast, the causal feedback loops which reinforce smooth functioning of the system, and consequently assist in reducing or eliminating delays, are identified by reinforced loops (Rs). The causal feedback relationships between the influential factors and the conceptual SD model are presented in Table 3 and Figure 1, respectively.

4.2.1 Causal feedback relationships, and the conceptual SD model

As mentioned in section 4.1, and as seen from Table 2, delays in progress of payment by the owner, slowness in decision-making by the owner, change orders by the owner during construction, poor communication and coordination by the owner and other parties, and delays in approving the shop drawings and sample materials by the client are the major client/owner-related factors which cause delays, although other factors contribute to a lesser extent. It is observed that there exist cause-and-effect relationships between these factors, and that they work through a causal feedback mechanism (see Table 3). Figure 1 depicts the conceptual SD model based on such causal feedback relationships. As shown in Figure 1, slowness in decision-making leads to delays in progress of payment, which cause delays and disrupt the system, through balancing loop B1. Also, poor communication leads to slowness in decision-making, and vice versa, through balancing causal feedback sub-loop B1A. So, sub-loop B1A aggravates the actions of balancing loop B1. Besides, factors such as change orders during construction, delays in approving the shop drawings and sample materials, late approval of revision of design, and delays in furnishing the site delivery by the client are influenced by slowness in decision-making, and vice versa. By contrast, effective communication between stakeholders (which can be enhanced by coordination between them) will assist in decision-making, which will facilitate timely payment, and consequently will assist in reducing construction delays from the client's side. However, to achieve this, measures such as coordination between stakeholders, which will lead to effective communication, availability of the requisite information, to aid timely decision-making, and availability of funds and an adequate budget allocation, which will allow for timely payment, are necessary.

Thus, the feedback mechanism involving effective communication, timely decision-making, and timely payment will promote a reduction in delays, through reinforcing loop R1. As a result, the disrupting effects of feedback mechanisms B1 and B1A are balanced, or negated, by feedback mechanism R1. So, the causal feedback relationships between communication, decision-making, progress of payment, and construction delays are the dynamic hypotheses, which influence delays, and they need to be attended to, so as to develop remedial mechanisms to alleviate the problem.

Table 3: Cause-and-effect relationships between client-related factors

Cause	Effect	+/–	Sources
Slowness in decision-making by the owner	Delays in progress of payment by the owner	+	Aibinu and Odeyinka (2006); Al-Kharashi and Skitmore (2009); Odeh and Battaineh (2002); Semple et al. (1994)
Delays in progress of payment by the owner	Delays in construction	+	
Poor communication and coordination by the owner and other parties	Slowness in decision-making	+	Ahsan and Gunawan (2010); Aibinu and Odeyinka (2006); Assaf et al. (1995); Abd El-Razek et al. (2008); Lo et al. (2006); Semple et al. (1994)
Delays in furnishing and delivering the site to the contractor by the owner	Slowness in decision-making	+	Aibinu and Odeyinka (2006); Al-Kharashi and Skitmore (2009); Odeh and Battaineh (2002); Faridi and El-Sayegh (2006); Semple et al. (1994)
Change orders by the owner during construction	Slowness in decision-making	+	
Lateness in revising and approving the design documents by the owner	Slowness in decision-making	+	
Delays in approving the shop drawings and sample materials by the owner	Slowness in decision-making	+	
Unavailability of incentives for the contractor to finish ahead of schedule	Delays in progress of payment by the owner	+	Aibinu and Odeyinka (2006); Al-Kharashi and Skitmore (2009); Odeh and Battaineh (2002); Semple et al. (1994)
Coordination between stakeholders	Effective communication	+	Ernst & Young (2011); KPMG and PMI (2012)
Availability of the requisite information	Timely decision-making	+	
Availability of funds and an adequate budget allocation for the project	Timely progress of payment	+	
Effective communication	Timely decision-making	+	
Timely progress of payment	Delays in construction	–	

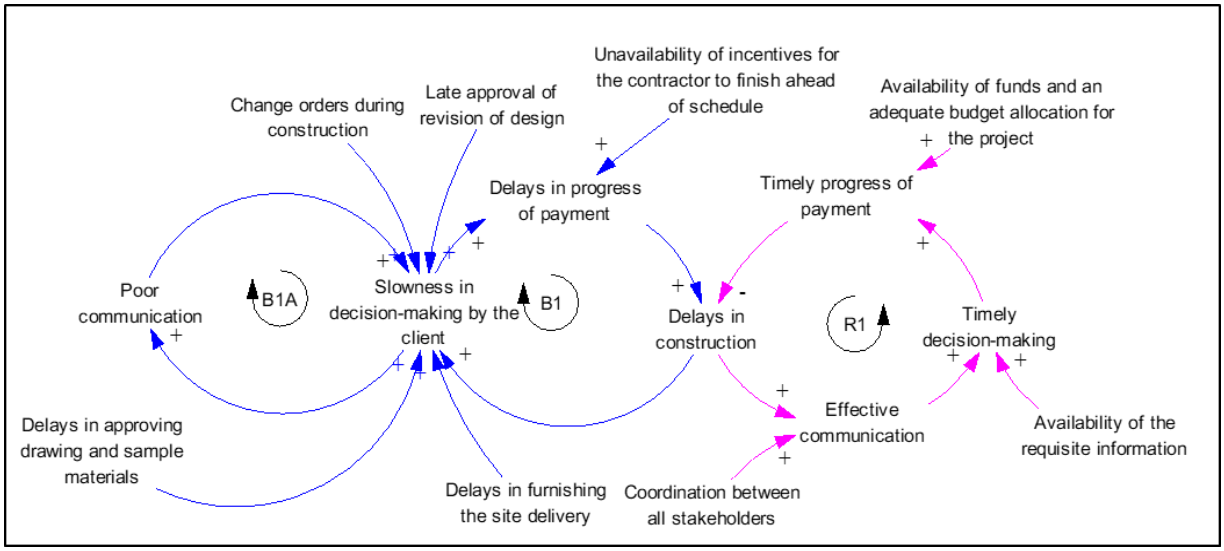

Figure 1: An SD model based on causal feedback relationships between the client/owner-related factors causing delays

4.3 Validation of the causal relationships

Validation of the causal relationships and SD models is crucial before using them for deriving mechanisms for policy/strategic interventions. So, the causal relationships and SD models were discussed with a different set of professionals and experts to those from the construction industry who were consulted during the survey, so as to validate the causal relationships used in the models (as mentioned in the methodology section). Based on the suggestions and judgements of the experts, the constructed causal relationships were adjusted, and the models were refined, so as to represent real scenarios in the construction project environment. Besides this, the validity of the causal relationships was also tested qualitatively, through test structure verification (where the cause-and-effect relationships were verified).

4.4 Mechanisms for policy interventions

Figure 2 depicts the causal feedback mechanisms derived from the dynamic hypotheses that are obtained from the SD models, based on which policy interventions can be derived. It shows how construction delays are influenced by various client-related factors. First, they are influenced by slowness in decision-making by the client, which is caused by several factors, such as poor communication, change orders during construction, delays in approving the shop drawings and sample materials, lateness in approving the revised design, and delays in furnishing the site delivery. Second, they are influenced by delays in progress of payment, which are essentially caused by slowness in decision-making. These variables are found to be connected in a chain of actions. However, timely decision-making, which is one of the most significant

variables, can be reinforced by availability of the requisite information and effective communication. Timely decision-making, together with availability of funds and an adequate budget allocation, will ensure timely progress of payment, which essentially should be able to reduce construction delays.

The mechanisms as depicted in Figure 2 also indicate that all the factors are linked to each other through a chain of actions activated by causal relationships, and they influence each other through appropriate feedback mechanisms. Figure 2 also clearly shows how the factors influence each other, and how the mechanisms work. So, the mechanisms provide the scope to diagnose the challenges at various stages of the construction work, on which timely and appropriate interventions can be taken to address the problem, which will assist in reducing delays in construction projects.

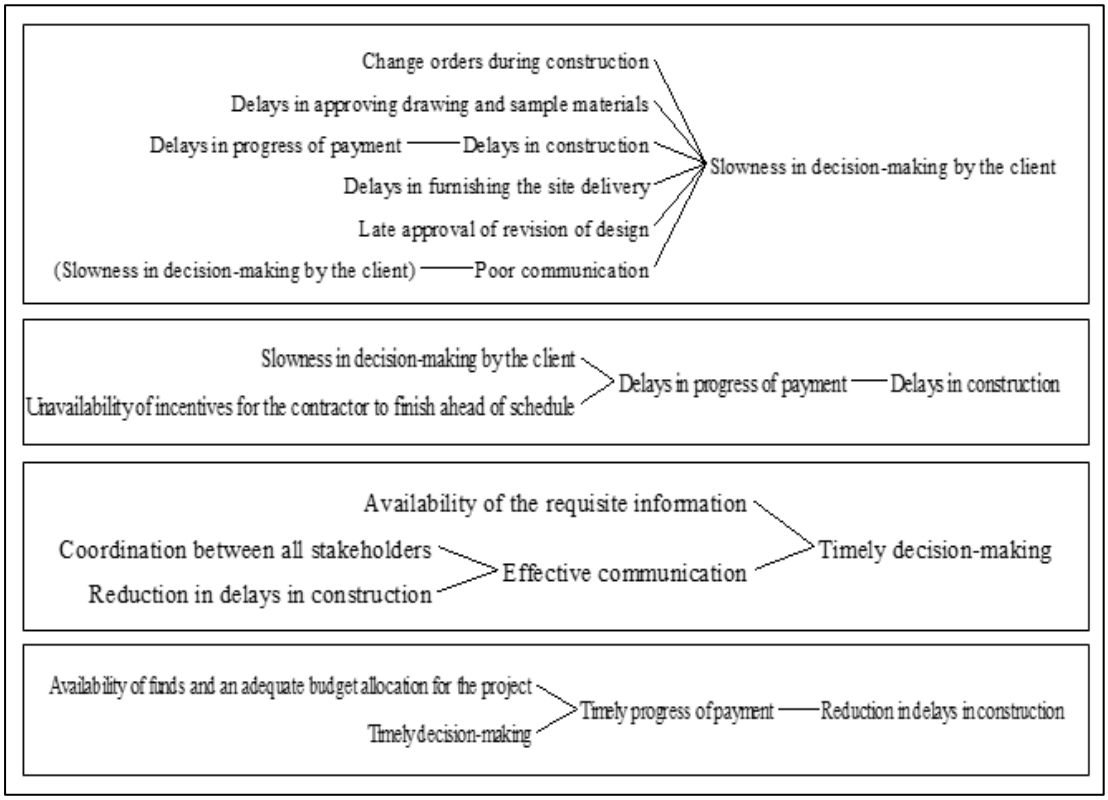

Figure 2: Mechanisms to understand client-related construction delays, and ways to reduce them

5. CONCLUSION

Delays in construction projects are a menace, particularly in India. They lead to appreciable overruns in both cost and time. Although there are plenty of studies that have been conducted to investigate the causes of construction delays, which vary depending on the context, there are several causes that are observed to be common in most of the projects. However, there is a paucity of literature available on the

mechanisms which could aid in developing policy interventions to reduce or eliminate construction delays. This gap in the research has warranted this investigation.

The investigation examined the various client-induced factors that influence the occurrence of project delays in construction, and it developed mechanisms based on the causal feedback relationships between the various client-related factors influencing delays in construction projects. To realise the objectives of the investigation, the survey research method was used, followed by development of a conceptual SD model. Before the conceptual SD model was developed, an evaluation was conducted based on a delay index developed with the exploratory survey data obtained from construction projects in India. It was revealed that delays in progress of payment by the owner, slowness in decision-making by the owner, change orders by the owner during construction, poor communication and coordination by the owner and other parties, lateness in revising and approving the design documents by the owner, delays in approving the shop drawings and sample materials by the owner, and delays in furnishing and delivering the site to the contractor by the owner are the major client/owner-related factors which cause delays. The mechanisms from the SD model indicate that delays are influenced by slowness in decision-making by the client, which is caused by poor communication, change orders during construction, delays in approving the shop drawings and sample materials, lateness in approving the revised design, and delays in furnishing the site delivery. Furthermore, delays in progress of payment, which essentially cause delays in construction, are engendered by slowness in decision-making. However, timely decision-making, reinforced by availability of the requisite information and effective communication, together with availability of funds and an adequate budget allocation, can ensure timely progress of payment, which essentially should be able to reduce construction delays.

The major contribution of the article is that it explicitly shows the causal feedback relationships between the client-induced variables causing construction delays, and it shows the mechanisms on which they work, in a chain of actions, reference to which is scarce in the existing body of literature. The article also goes beyond identification of the causes of delays and their level of influence, offering ways to develop mechanisms for diagnosing the problems at different stages of construction work, and to develop policy interventions to take remedial measures. It also offers a methodological avenue to analyse construction delays by using SD principles.

The article has its limitations, however. The obvious limitations are that the modelling was done conceptually, although the basic premise behind it was to see the challenge of delays in a more critical way. However, there is a need for the quantitative modelling to examine the extent to which construction delays can be reduced or eliminated under different scenarios of strategic/policy interventions, based on the dynamic hypotheses derived from the conceptual model, in which there is scope for further research.

6. ACKNOWLEDGEMENT

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