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## **Delay Factors in Construction of Healthcare Infrastructure Projects: A Comparison amongst Developing Countries**

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# **Delay Factors in Construction of Healthcare Infrastructure Projects: A Comparison amongst Developing Countries**

## ***Abstract***

Creation of large healthcare infrastructure facilities involves complex construction projects. These complex projects face the risk of poor delivery in terms of time adherence and end up in delays. Identification of sector-specific factors of delay at a regional level can help with timely delivery of projects. This paper intends to investigate the challenges in the construction of hospitals in India. The study was based on a qualitative approach and used content analysis to investigate the factors responsible for the delay. Semi-structured interviews were carried out to collect the data from project managers, architects, site engineers, service consultants, and administrative heads. A list of the six most critical factors of the delay was derived. The delay factors in the Indian healthcare construction were compared with the findings of similar investigations conducted in other developing countries. The findings of the study can benefit the project managers and organizations to efficiently manage the construction of similar projects and help in the reduction of instances of delay. The learnings from the study apply to healthcare projects in the regions with similar challenges. Further, the subject demands regions specific investigations.

Keywords: delays; healthcare projects; construction management; challenges; delay factors

## **1 INTRODUCTION**

Delay in construction projects is a severe and chronic problem (Kazaz and Ulubeyli 2009). Enshassi et al. (2009) mentioned the delay in construction as one of the most critical factors affecting project performance. There are substantial studies in the field of construction project management, and delays have been analysed from different viewpoints. A majority of studies deal with the identification of factors of delay and parties responsible for the delay (Sullivan and Harris 1986; Kaming et al. 1997; Mezher and Tawil 1998; Fimpong and Oluwoye 2002; Long et al. 2004; Assaf and Al-Hejji 2006; Faridi and El-Sayegh 2006). Another set of works investigates the effect of construction delay (Scott 1993; Sambasivan and Soon 2007), delay claims and disputes (Semple et al. 1994, Iyer et al. 2008) on project success. Similar studies related to delay and time-overruns highlight that inadequate project management is responsible for failure to comply with the scheduled timeline of the project (Mansfield et al. 1994, Mezher and Tawil 1998; Al-Momani 2000; Assaf and Al-Hejji 2006; Sweis et al. 2008). The late completion of projects leads to cost overruns, disputes, litigation, arbitration and total abandonment (Sambasivan and Soon 2007; Amoatey et al. 2015; Pawanhari

et al. 2016). Regardless of the severe impacts of the delay, the projects spread across various sectors of infrastructure construction in the developed and developing regions of the world are continuing to observe substantial delays. These effects of delay present a serious challenge for the project managers to get the project completed on time and within the stipulated cost. Identification of factors responsible for the delay is the essential step towards improving the project time performance (Al-Momani 2000).

Many of the presented studies discuss the various techniques of delay analysis and suggest recommendations for improving the time performance of projects. So far, researchers have focused mainly on the delay studies for construction projects in general. Despite having various attempts to find a generic solution to mitigate delays, the performance of projects continues to be poor and delay in projects seems inevitable. The peculiar set of requirements makes every sector unique regarding the need to investigate the challenges and factors of delay. Given the diversity in construction projects with differing scale, nature, complexity, type of services, the technology required and end-users, the approach to find common factors of delay for all construction project types appears to be a fallacy.

Delay in hospital construction projects in India is quite common and has not been given the desired attention. This paper explores the factors of delay in construction of hospital projects in India using semi-structured interviews. Shortlisted factors from the literature review form the base of the investigations conducted during the interview. Discussion of the most important factors provides an understanding of the critical aspects to be considered by the project managers involved in the construction of similar projects.

## **2 HOSPITALS: COMPLEX PROJECTS**

Lam et al. (1997) describe the attributes of a hospital and a high level of complexity in these highly serviced social infrastructure projects. Hospitals are characterized by multiple building components and systems, distinct stakeholders' needs, continuous technological innovations, specific functions, and particular building codes and regulation to comply. These set of features make the construction of such facilities complicated and a challenging task for the project participants. The element of uncertainty attached to the nature of hospital projects makes their construction a complex process (Doulabi and Asnaashari 2016). These capital-intensive buildings have a complex network of services to facilitate wide-ranging functions. Nelson (1990) averages out the cost of building services in hospital buildings at around 50% of the total expenditure on construction. The building requires detailed planning and design responding to the requirements of diverse end-users. Lam et al. (1997) state that hospital buildings demand a complete

integration of specialized and detailed building services in the design. The integration of ICT (Information and communication technology) also plays a key role and is responsible for enabling these buildings to perform more efficiently. The fast-paced innovations and advancements in the clinical practices followed by technological updates demand hospital design to be flexible (Olsson and Hansen 2010). A detailed, comprehensive design can prevent clash during the execution of the project and efficient project management can facilitate the coordination of different agencies working together. Hence, the role of designers and project managers becomes crucial for the successful implementation of such projects. All these characteristics make the execution of such projects challenging. Most of the hospital projects in India face excessive delays during the planning and execution phases (Tandon 2017). Hence, to address the frequent occurrence of delays in hospital construction projects a dedicated study for the identification of the challenges and factors responsible for delays is required.

### **3 LITERATURE REVIEW**

Many research studies have been conducted related to the investigation of delays in various category of construction projects. Delay in construction projects is defined as an act or event that prolongs the time and budget limit specified for deliverables under the contract that the parties agreed upon (Assaf and Al-Hejji 2006; Lo et al. 2006). A large number of activities in the construction projects adds to the complexity and difficulty of analysing the delays (Shi et al. 2001). Identification and ranking of factors of delay can assist to monitor the deficiencies and lead to the mitigation of delays by considering the significant factors (Hussain et al. 2018). Assaf and Al-Hejji (2006) suggested identification of delay factors to reduce the impact of delays.

Many researchers have studied the diverse causes of delay in construction-based projects. Arditi et al. (1985) investigated reasons for delays in public projects in Turkey. The results indicate that a shortage of resources; financial difficulties of public agencies and contractor; organizational deficiencies and delays in design work, frequent change orders, and considerable extra work are the most important reasons for the delay. Okpala and Aniekwu (1988), in a study based in Nigeria, found that delays are a major reason behind the high costs in construction projects. The study finds that the delays and direct cost overruns of a project are the principal factors leading to the high cost of construction. Dlakwa and Culpin (1990) worked on the reasons for the delay in public sector construction projects in Nigeria. The research identified that the lack of prompt payment by agencies to contractors and fluctuations in material, labour and plant costs are the

major reasons for the delay. Mansfield et al. (1994) studied the highway projects in Nigeria using a questionnaire survey approach. The study mentioned finance and payment arrangements, poor contract management, materials shortages, inaccurate estimating, and overall price fluctuations as the most contributing reason for delays in the highway projects. Semple et al. (1994) studied the implication of construction claims and disputes on time and cost overruns. Civil, institutional, high-rise apartment building and petrochemical projects were investigated, and the study indicated that changes, disputes, soil/site conditions, and delay are the critical elements of the construction contract. Ogunlana et al. (1996) conducted a comparative study of construction delays in Thailand and other economies. The study concluded that construction in developing countries faces problem of inadequate infrastructure, shortage of supply of resources, problems arising of clients and consultants, and problems caused due to the incompetence of contractors. Chan and Kumaraswamy (1996) and Lo et al. (2006) studied construction delays in Hong Kong civil engineering projects. The common factors of delay as cited by most of the studies include financial difficulties, inclement weather, the inadequacy of resources, material shortage and poor project coordination. Chan and Kumaraswamy (1996) found differing perceptions of clients, contractors, and consultants regarding the factors of delay. Ahsan and Gunawan (2010) conducted an empirical analysis of cases from four developing countries to examine the cost and time performance of international development projects. The causes of project delay were identified in the study. In a comparative analysis, the average schedule overrun in India was found to be the highest (55% of the scheduled time) as compared to Bangladesh, China, and Thailand. Table 1 presents a summary of previous works on construction delays.

Table 1: Summary of Previous Works on Construction Delays

<b>Researchers</b>	<b>Region</b>	<b>Delay aspect studied</b>	<b>Delay Factors</b>
<b>Semple et al. (1994)</b>	Canada	<i>Factors of delay</i>	(1) Increase in scope of the work; (2) Weather; (3) Restricted access; and (4) Acceleration
<b>Mansfield et al. (1994)</b>	Nigeria	<i>Causes of delay</i>	Poor Contract management; (2) Financing and payment of completed works; (3) Changes in site conditions; (4) Shortage of materials; (5) Imported materials and plant items; (6) Design changes; (7) Subcontractors and nominated suppliers

<b>Mezher and Tawil (1998)</b>	Lebanon	<i>Responsible parties of delay; factors of delay</i>	(1) Cash problems during construction; (2) Design change by owner; (3) Preparation of shop drawings; (4) Preparation of scheduling work; (5) Lack of personnel training and management support
<b>Al-Momani (2000)</b>	Jordan	<i>Causes of delay; Construction claims</i>	(1) Design changes; (2) Disputes; (3) Notification of extra work; (4) Date of notice to proceed; (5) Delay encountered during construction; (6) Conflict of the drawings and specifications; (7) Time extensions; (8) Late delivery of materials and equipment.
<b>Frimpong and Oluwoye (2002)</b>	Ghana	<i>Factors of delay</i>	(1) Monthly payment difficulties; (2) Poor contract management; (3) Material procurement; (4) Inflation; (5) Contractor's financial difficulties
<b>Long et al. (2004)</b>	Vietnam	<i>Responsible Parties for delay, Factors of delay</i>	(1) Poor site management and supervision; (2) Poor project management assistance; (3) Financial difficulties of owners; (4) Financial difficulties of contractor; (5) Design changes
<b>Assaf and Al-Hejji (2006)</b>	Saudi Arabia	<i>Responsible parties for delay, Factors of delay</i>	(1) Shortage of labours; (2) Delay in progress payments by owner; (3) Type of project bidding and award; (4) Unqualified workforce; and (5) Late in reviewing and approving design documents by owner.
<b>Faridi and El-Sayegh (2006)</b>	United Arab Emirates	<i>Factors of delay</i>	(1) Preparation and approval of drawings; (2) Inadequate early planning of the project; (3) Slowness of the owner's decision-making process; (4) Shortage of manpower; and (5) Poor supervision and poor site management.
<b>Iyer et al. (2006)</b>	India	<i>Factors of Delay</i>	(1) Commitment of project participants; (2) Owner's competence; and (3) Conflicts among project participants

<b>Sweis et al. (2008)</b>	Jordan	<i>Causes of delay</i>	1) Poor planning and scheduling of the project by the contractor; (2) Financial difficulties faced by the contractor; (3) Too many change orders from owner; (4) Shortage of manpower; and (5) Incompetent technical staff assigned to the project.
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Most of these studies present the findings in the form of ranking of factors of delay. However, there is a difference in their results as to which factor should be given the maximum importance among the identified factors of delay while looking for project management interventions. The top-ranked factors also vary in each of these studies depending on the nature of projects and regional setting. It highlights the need to conduct sector-specific studies at the regional level as the project conditions vary largely with the political, technological, geographical and cultural settings.

On the other hand, the creation of the most vital infrastructure sectors with construction as a significant activity includes transport, power, residential, telecom, healthcare and education projects. Projects in almost all sectors experience substantial delays. Kaliba et al. (2009) studied the construction of road projects in Zambia and identified the major causes of delay. Mahamid et al. (2011) explored the perspective of contractors and consultants on the causes of delays in the road construction projects in the West Bank region of Palestine. Kamanga and Steyn (2013) found that resource-based and financial causes contributed to delay in road construction projects in Malawi. Seboru (2015) used purposive sampling and conducted a questionnaire survey to extract the top five causes of project delays in the road construction project in Kenya. Ekanayake (2016) studied the common techniques used for delay analysis of road projects in Sri Lanka. The study was based on expert interviews and questionnaire surveys. Santoso and Soeng (2016) conducted a questionnaire survey and pointed out the critical delay factors for road construction projects in Cambodia. Afshari et al. (2011) identified the non-excusable delays of executive companies in order to improve time performance of the projects including thermal power plant, steam, and power. Odeyinka and Yusif (1997) studied the construction delays in housing projects in Nigeria and categorised the delay factors related to partners of the project and external agents. Sweis et al. (2008) research the causes of delay in residential construction projects in Jordan. Desai and Bhatt (2013) identified the causes of delay in residential construction projects of the Indian construction industry by interviewing developers, contractors, and architects. Frimpong et al. (2003) calculated the relative importance of the factors



responsible for delay in Ghana groundwater construction projects using a questionnaire survey. These studies provide evidence of research on construction delays in road, power, residential and other physical infrastructure sector projects.

However, the phenomenon of delay in hospital construction in India has not received the desired attention. Kim et al. (2016) analysed the factors that cause delay the time of hospital projects in Vietnam using factor analysis, survey expert and the concept of correlation. Doulabi and Asnaashari (2016) identified the success factors of healthcare facility projects by interviewing practitioners with substantial experience in the construction of healthcare facilities in Iran. Only limited attempts have been made to investigate hospital project delays. Hence, the study mainly focuses on healthcare sector projects, which is one of the relatively less explored areas in construction delay investigations. To fill the knowledge gap, this study explores the challenges in the construction and investigate the factors of delay in Indian hospital projects. Further, the findings of this study are compared with two similar studies in Iran and Vietnam. The outcome of the study finds application in deciding the contract terms and conditions for projects in developing regions, resulting in timely delivery of projects.

#### **4 RESEARCH METHODOLOGY**

A qualitative approach based on semi-structured interviews forms the basis for this descriptive research. A pilot survey was conducted to prepare a refined list by narrowing down the factors for delay in hospital construction projects. The challenges and delays in hospital construction were analysed from the perspective of professionals involved in planning, construction, decision-making and project management. The interview was conducted with the project managers, architects, consultants, engineers and client representatives involved in various hospital construction projects. In total, 14 professionals, including 7 representing the client, 4 representing the consultant and 3 representing the contractor, were interviewed. The period of study was from 8 February 2018 to 25 May 2018. To allow interviewees to respond freely and share the peculiar problems faced during the project cycle, an open-ended format for the interview was adopted. The details of the professionals are presented in Table 2.

Table 1: Profile of the Interviewees

No.	Stakeholder Represented	Current Designation	Experience (in years)	Projects worked upon
1.	Client	<i>Hospital Architect</i>	8 years	PGIMER Chandigarh
2.	Client	<i>Project Manager</i>	4 years	AIIMS Jodhpur

3.	Client	<i>Project Engineer</i>	7 Years	AIIMS Bhopal
4.	Consultant	<i>Project Architect</i>	8 Years	Rajiv Gandhi Institute of Medical Sciences Adilabad, AIIMS Bhopal
5.	Consultant	<i>Senior Architect</i>	5 Years	GMC Rajkot
6.	Consultant	<i>Assistant Architect</i>	1 Year	AIIMS Bhopal
7.	Contractor	<i>Site Supervisor</i>	12 Years	Fortis Super Speciality Hospital-Delhi, AIIMS- Delhi
8.	Contractor	<i>Project Site Manager</i>	7 Years	PGIMER Chandigarh
9.	Contractor	<i>Site Engineer</i>	2 Years	PGIMER Chandigarh
10.	Client	<i>Professor</i>	22 Years	AIIMS Delhi
11.	Consultant	<i>Services Engineer(HVAC)</i>	12 Years	Care Hightech City Hospital Hyderabad, Lifeline Hospital Jhansi
12.	Client	<i>Professor</i>	20 Years	AIIMS Delhi
13.	Client	<i>Administrative Head</i>	25 Years	AIIMS Raipur
14.	Client	<i>Administrative Head</i>	35 Years	PGIMER Chandigarh

#### 4.1 Sampling Method

For the selection of respondents, a non-probabilistic sampling method of snowball sampling was used to obtain the responses. As the targeted respondents were the professionals with very particular work experience, snowball sampling suited well for the purpose. The method of snowball sampling is generally used when potential participants are hard to locate, and the study is based on a specific and subtle issue (Etikan et al. 2016). In this sampling approach, the size of the sample is decided based on the saturation of information. The data are gathered until the samples fetch new facts, findings, and information. Content analysis a research technique for interpreting the texts and making replicable and valid inferences to the contexts of their use (Krippendorff 2004) was used in this analysis. The collected data was analysed using de-contextualization, re-contextualization, categorisation, and compilation, leading to the identification of the critical factors causing delays in healthcare projects.

#### 4.2 De-contextualization

In the first step of data analysis, i.e., de-contextualization, the transcribed interviews were read to have a familiarization with the content. This step enabled an understanding of the whole set of data. Meaning of long sentences was split into small meanings referred to as meaning units and was labeled as a code. As the major categories of factors of delays were known from the literature review, deductive reasoning design was used, where a coding list is prepared before the analysing process.

#### *4.3 Re-Contextualization*

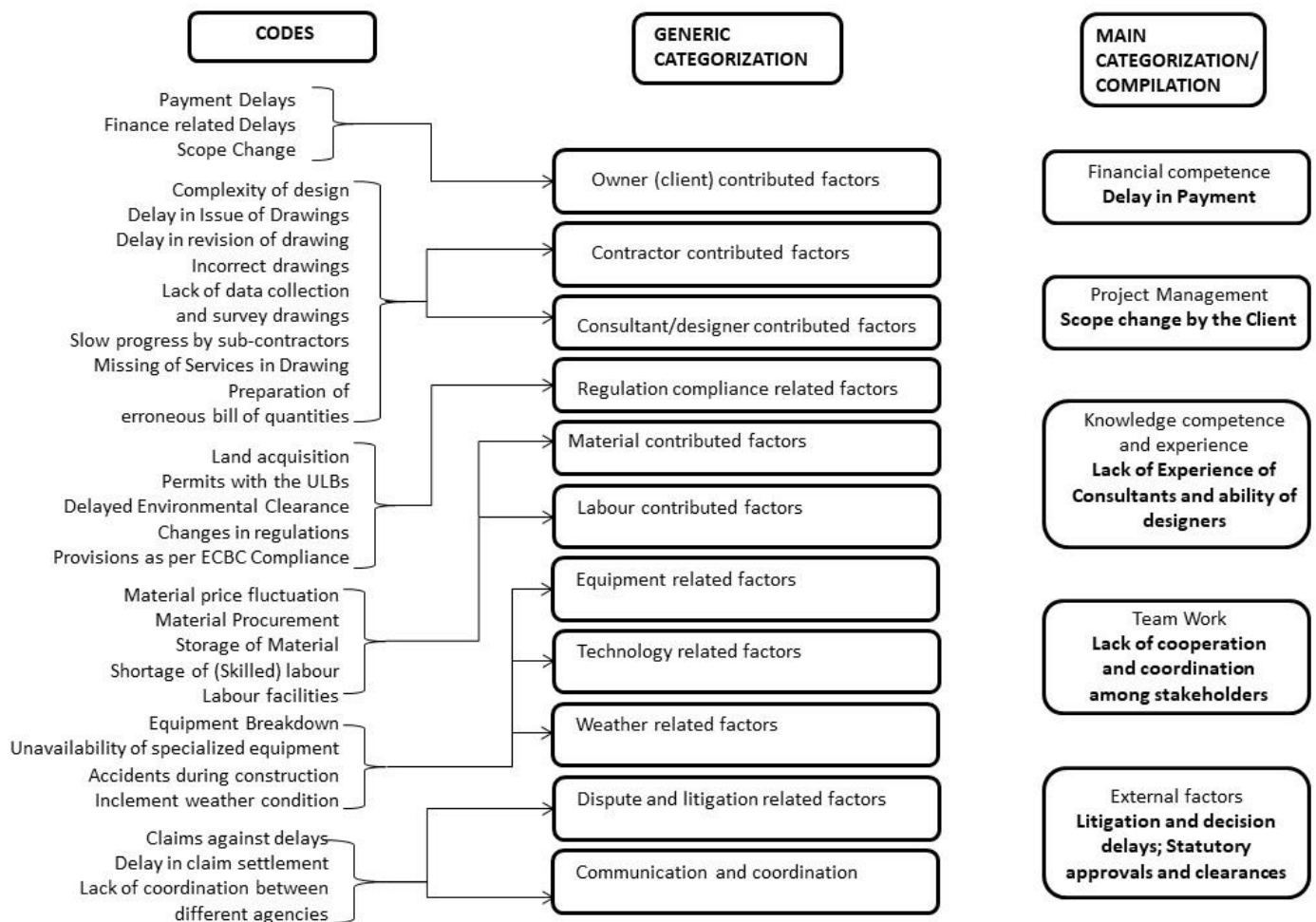
The second step of re-contextualization involved checking for any missed out points from the transcripts. In this step, the content was revisited and checked with the final list of meaning units.

#### *4.4 Categorization*

The next step of categorization comprised of condensing the codes to generic categories and subsequently to arrive at the main category. Homogeneous groups were identified for categorisation. Krippendorff (2004) prescribed that data should neither fall between two groups/ categories nor should fit into more than one group.

#### *4.5 Compilation*

Categorization was followed by analysis and compilation of study results. Realistic conclusions were drawn from the compiled factors. After the compilation of a final list of factors, inquiry audit was conducted to validate the findings. In the end, the findings were compared with the literature to check the variation in results. The codes, generic categorisation, and main categorisation as explained in the diagram presented in Figure 1.



**Figure 1 Content Analysis Flow Diagram**

## **5 DISCUSSION OF ANALYSIS RESULTS**

A variety of factors, spread across different phases of a project, is responsible for construction project delays. The study resulted in differing results as the top factors of delay showed deviation from the outcomes of previous researches on the subject matter (Arditi et al. 1985; Chan and Kumaraswamy 1997; Kaming et al. 1997; Walker and Vines 2000; Faridi and El- Sayegh 2006; Sambasivan and Soon 2007). The results highlighted the unique delay factors specific to healthcare projects executed in the Indian context. A set of client-related factors, consultant related factors and external factors comprised the findings of the study. The discussion includes the details of the identified six most important factors of delay.

### *5.1 Lack of experience of consultants and ability of designers- Repeated revision of drawings and inputs*

Projects are liable to failure when management misses the technical aspects of design. Designing and timely production of 'Good for Construction' drawings has a very significant role in the timely completion of any construction project. Quality of drawings determines the project success (Couto 2012). Design errors commonly characterise construction drawings. Sweis (2013) researched the factors affecting the time performance of public construction projects in Jordan and found that poor qualification of consultants, engineers, and staff deployed on the project was the top-weighted reason of delay. Eleven of the respondents mentioned that drawing related issues resulted in repeated corrections. These corrections took a substantial amount of time to produce the revised set of drawings. The drawings were to be approved from the concerning team, and the process ultimately resulted in delays. Interviewee project managers, site engineers, and the administrative heads shared that the sub-optimal competency of the design and engineering team and lack of experience in designing and detailing of hospital projects were responsible for the repeated revision in drawings. The design errors by the consultant are covered in the liability of the owner for the extra costs incurred by the construction contractor (Bramble and Callahan 2000). The interviewees mentioned that a majority of the delay claims, arising because of sub-optimal drawings, settled in favour of the contractor. Hence, the onus of selection of a competent consultant lies with the government, as they are the client in most of the public healthcare projects.

### *5.2 Delay in payment*

Payment to service providers is considered as the lifeblood of the construction industry because of the highly capital-intensive nature of the projects (Ameer-Ali 2005). Construction of hospitals involves very large capital outlays and accounts for 60-80 percent of the government expenditure for health facilities in developing countries (Barnum and Kutzin 1993). The delay in payments from the client affects the project progress, though the contractors are liable to receive payments as per the contract against the work done. Nine out of the fourteen interviewees mentioned the delay in payments as a leading factor of delay in the construction projects. The projects mentioned by the respondents cost more than 20 million GBP each. Responses from the construction project managers mentioned that the delay in payments has a percolating effect to the other stakeholders of the project. Payment delays are identified as a retarder in project progress, which is responsible for inefficiency and low productivity levels (Cheng et al. 2009; Ye and Rahman 2010; Ramachandra and Rotimi 2012). Late payment has a cascading effect on the construction project and affects

all the parties down the contractual chain (Latham 1994; Lip 2003; Nicholas 2005). Interview response from a site engineer mentioned that late payment to the contractor influenced the availability of labour and timely delivery of materials for the following work in the project under his supervision. Delayed payment to contractors also results in disputes and severely affects the progress of the project. Three interviewees shared that clients' delay in certification of work was responsible for not releasing the funds and it had implications on the quality and overall flow of the project work.

### *5.3 Scope change by clients and variation in work*

Ibbs (2005) accepted that changes are inevitable in the case of construction projects and can take place in any phase of the project. The impacts of changes in the early stage of the project are relatively easier to recover as compared to those taking place in the later stages. Scope change during construction leads to changes in design, reworks, and causes time overruns (Love and Edwards 2004). Generally, construction contracts allow the owner to amend the general scope of the contract within the terms of the contract (Bramble and Callahan 2000). In many projects, the owners of public projects consider a code or standard for reference. During the execution of the project, the codes and standards get updated, or otherwise, some new rule or regulation is issued. To fit within the prescribed standards, the scope of the project is revised. It leads to complete change of the design responding to the revisions in the scope change. Ten out of the fourteen interviewees mentioned instances of scope changes or client variations in the planning and construction phase of the project. The high frequency of occurrence of design variations is consistent with the outcomes of similar studies. These previous studies established that scope change is one of the significant factors responsible for delays in construction projects in regions of Turkey, Indonesia, Jordan and Egypt (Arditi et al. 1985; Kaming et al. 1997; Sweis et al. 2008 and El- Razek et al. 2008).

### *5.4 Litigation and decision delays*

The interview responses yielded mention of four major undergoing hospital projects, worth more than GBP 100 million each, facing delays due to litigation cases filed by the contractor and consultants. The judgement in the seven major litigation cases was in favour of contractor and consultant. Delay in payments to the contractors and consultants was one of the major reasons for litigation. Project litigation and the decisions caused substantial delays of up to 30 months in a project and caused a notable time lapse in the other projects. The other mentioned causes of litigation included change orders, poor quality of work,

inaccurate estimates and differing site conditions. An investigation by Sambidge (2013) in the Middle East found that the legal disputes take 14.6 months on an average to resolve. The other cases of litigation affected the client by imposing an extra financial liability in the form of delay claims to contractors and consultants. Delay claims are a major source of conflict in the construction industry and one of the most difficult to resolve (Finke 1999; Pichavance 2010). Leishman (1997) discussed the legal consequences of delays and time overruns in construction projects.

#### *5.5 Delay in getting statutory approvals/clearance*

The interviewees stated instances of severe delays up to 24 months during hospital construction as an outcome of delay in getting the environment clearances and approvals. An interview response from an architect mentioned that complete disruption of workflow was observed when the construction of a 250-bedded hospital was found to be assigned without environmental clearance. Approval from the local authorities and statutory compliances are an essential part of a construction project. These approvals are necessary to set a standard, ensure the safety of life and property and collect revenues (Muiruri and Mulinge 2014). Gachie (2011) cited some outcomes of delay in getting approvals, including delayed projects, cost overruns, lost revenues and loss of employment opportunities. The main approvals and compliance list followed for large construction projects in India consist of compliance of water management during construction, rainwater harvesting provisions, compliance to the reduction of pollution during material transportation, solid waste management, construction, and demolition waste management and energy conservation. The checklist for Environmental Impact Assessment (EIA) includes details of land environment, water environment, vegetation, Fauna, air environment, aesthetics, socio-economic aspects, building materials, energy conservation, and energy management plan. Compliance with the comprehensive list of requirements, production of reports and approval takes a considerable time during the project. It causes a delay in the project and affects the overall project performance.

#### *5.6 Lack of cooperation and coordination between stakeholders*

Iyer and Jha (2006) highlighted the importance of cooperation and coordination among different stakeholders for timely completion of a project. The authors opined that absence of support amongst the parties involved in construction impedes the progress of work and leads to delays in completion. Mezher and Tawil (1998) studied the construction delay causes in Lebanon and identified the lack of coordination

as one of the major causes of delay. Kadir et al. (2005) found that the coordination problem between the contractor and sub-contractor was one of the five most frequent factors of delay in Malaysian residential construction projects. El-Razek et al. (2008) in a research-based in Egypt found that inefficient and poor coordination between the parties causes reworks and lead to delays. Nine out of the fourteen interviewees mentioned about severe coordination-related issues in the projects. The feedback from project managers highlighted the absence of coordination among the stakeholders of the project. In the analysis of responses, the relationship of the consultant with the other stakeholders was found to be relatively poor. On the contrary, healthy coordination among the stakeholder including the owners, contractors, subcontractors, designers, suppliers and other consultants, ensures a smooth execution of the project and keeps a check on miscommunication.

The other factors of delays in hospital projects include- unforeseen subsurface and changing ground conditions; unavailability of labour in harvesting season and the organizational framework of the project monitoring team from the client side. Differing site conditions are sometimes responsible for a complete rework on cost estimates pertaining to the extraordinary measures to accommodate revision of the structure system, substantial site development works, and soil stabilization inputs. These inputs are time and capital intensive and ultimately affects the schedule compliance of the projects.

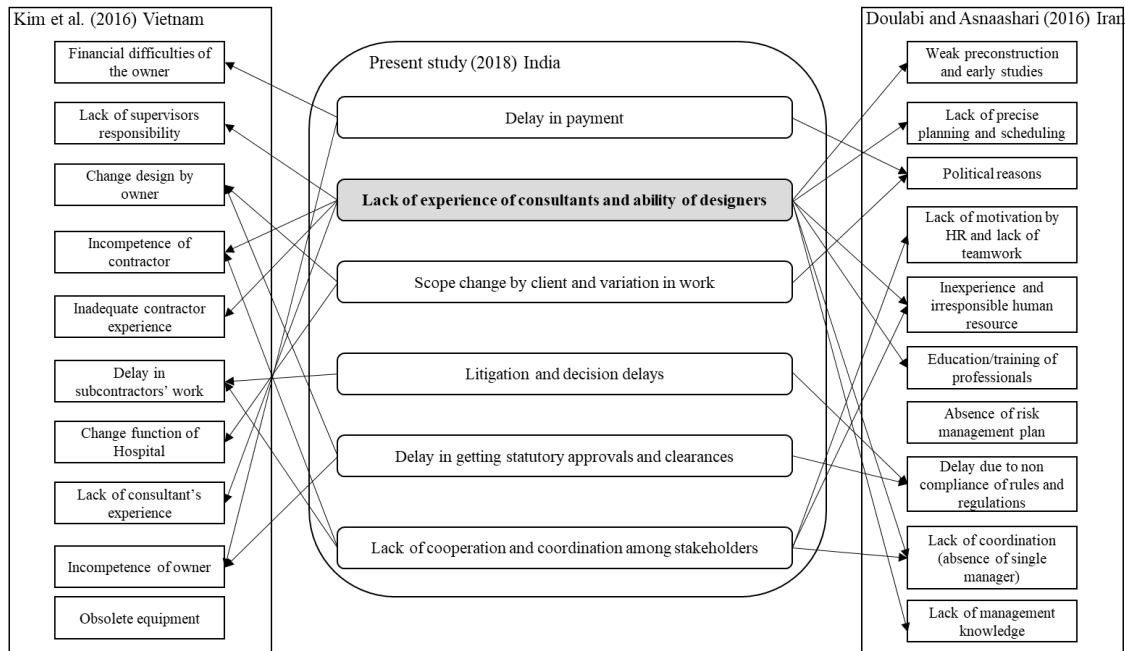
The results show that the most common delay factor for the case of hospital projects is the lack of experience of consultants and the ability of designers. It leads to a repeated revision of drawings and causes considerable delays in the planning and execution phases of the project. This finding highlights the deviation from the findings of other studies conducted for construction projects in general. Two of the other significant factors contributed by client include delay in payments and scope change by the client. Whereas, factors like litigation and decision delays and delay in getting statutory approvals and clearances constitute the external factors. Lack of cooperation and coordination emphasises on the distrust among the project participants.

## **6 COMPARISON OF FINDINGS IN DEVELOPING COUNTRIES AND WAY FORWARD**

The results of this interview-based study were compared with similar studies in the developing regions. The studies of delays analysis and identification of success factors for healthcare projects in Vietnam (Kim et al. 2016) and Iran (Doulabi and Asnaashari 2016) respectively were referred for comparison with the



findings of this study conducted in India. Both the studies used qualitative methods of research. Kim et al. (2016) used a questionnaire survey to derive the main reasons of delay, whereas Doulabi and Asnaashari (2016) conducted open-ended interviews to highlight the challenges and identified the success factors for hospital construction projects. Figure 2 presents the key findings of the studies under consideration.



**Figure 2 Comparison of Common Factors of Delay**

The findings of the three regions are comparable, and there exist common factors of delay in these regions. 'Lack of consultants' experience' (Kim et al. 2016) and 'Inexperienced and irresponsible human resource' (Doulabi and Asnaashari 2016) are found analogous with the 'Lack of Experience of consultants and ability of designers' in this study. This recurring factor of delay proves the unavailability of trained consultants and professionals to these highly engineered and serviced building campuses. On the other hand, 'lack of teamwork' and 'lack of coordination (absence of single manager)' are analogous with 'lack of coordination and cooperation.' The other common factors of delay include 'change design by owner' and 'scope change by the client and variation in work.' The comparison indicates that most of the delay factors are client and designer related. The degree of control and supervision of the client has a significant role in the successful execution of construction projects (Arabi et al. 2007). The comparison indicated that the lack of experience of consultants and ability of designers along with lack of coordination and cooperation among the stakeholders are the most common reasons for the delay in developing regions. In Indian projects, client and consultant based factors dominate whereas, in projects belonging to Iran and Vietnam, the contractor and consultant dependent factors contribute more to delays.

## **7 IMPLICATIONS AND LIMITATIONS**

The investigation was confined only to Indian public sector hospital construction projects. The considered projects for evaluation of delays in this study include teaching hospitals in India, which have patient care, teaching of professionals and research as their prime objective. The learnings from the study apply to healthcare projects in the regions with similar challenges. Further, the subject demands regions specific investigations.

## **8 CONCLUSION**

Delay analysis studies are considered an important step to identify the challenges in construction projects and serve as a guiding process for the mitigation of delays. This paper evaluates the factors of delay in hospital construction projects from the perspective of the key stakeholders of the project comprising of project managers, consultants, engineers, and administrative professionals using semi-structured open-ended interviews. The findings of the paper help to understand the underlying challenges in the construction of a complex service-intensive facility. It also reveals problems in the Indian construction industry, which often translates into a delay. The paper identifies a total of six factors responsible for the delay, including lack of experience of consultants and ability of designers; delay in payments; scope change by the client and variation in work; litigation and decision delays; delay in getting statutory approvals; and lack of communication and coordination among the stakeholders. The comparison of findings with similar studies in the developing regions of Vietnam and Iran revealed that lack of experience of consultants and the ability of designers acts as an impediment during the project planning and execution phases of such projects. It results in a repeated revision of drawings and leads to conflict among the execution team, the client and the consultant. These identified factors find utility in planning the delay mitigation measures for the successful delivery of hospital projects.

## **9 DISCLOSURE STATEMENT**

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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