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Investigating Delay Factors of Construction Projects in Metropolitan City of Lahore

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Abstract
The problem of delays in the construction industry is a global phenomenon and new metropolitan cities like Lahore is no exception. The main purpose of this study is to identify the delay factors and their impact (effect) on project completion and allocation of responsibility for delay causes. Earlier studies either considered the causes or the effects of project delays, separately. This study takes an integrated approach and attempts to analyze the impact of specific causes on specific effects and allocation of responsibility .A questionnaire survey was conducted to solicit the causes and effects of delay from clients, consultants, and contractors. About 26 respondents participated in the survey. This study identified 10 most important causes of delay from a list of 53 different causes and as result different effects of delay. Ten most important causes were: (1) Delay in Payments, (2) Poor Weather Conditions, (3) Less Use of Highly Technology Mechanical Equipment's, (4) Ineffective Planning and Scheduling of Project, (5) Rework Due To Errors during Construction, (6) Delay Due To Subcontractor, (7) Poor Site Conditions, (8) Coordination Problem with Other, (9) Late in Reviewing and Approving Design Documents, and (10) Unclear Design Details in Drawing. Five main effects of delay were: (1) time overrun, (2) cost overrun, (3) Arbitration, (4) loss of interest of stakeholder and (5) black listing. This study has also established an allocation of responsibility for each group of factors causing delay in construction projects. Overall responsibility allocation shows that contractor has 40%, consultant 21%, owner 9%, and 30 % responsibility shared among the stakeholder due to contingencies. This study helps foreign and indigenous stakeholders to monitor and control delay risk by understanding pivotal causes in context of Lahore.

Keywords
Delay factors, Delay effects, Construction projects, Lahore

1. Introduction

Construction industry plays a major role in the economic growth of a nation and occupies a pivotal position in the nation's development plan (Okema, 2000). Construction contracting is a high risk, dynamic and complex business, which is subject to a high level of uncertainty and features an industry that is fragmented and very susceptible to environmental influences (Khosrowshahi & Howes, 2005). Pakistan's construction industry is facing problems like other developing countries as shortage of

material, skilled personal and equipment; inadequate technology development; predominance of small and weak local firm; domination of large project sector of the industry by foreign firms; unsatisfactory procedures and contract documentation and highly unstable levels of demand and output. Construction project risks, if not managed properly, can lead to failure in achieving the desired project objectives, resulting in increased costs, time delays, lack of quality, and issues related to functionality of facilities. The risk management system and practices of most of the organizations in Pakistan are reactive, semi-permanent, informal, and unstructured, with little or no committed resources to deal with risks. There is barely any process of documentation of the risk management process by all parties, and is characterized as an informal and trivial effort (Choudhry & Iqbal, 2012). Time delay is vital risk factor for construction projects due to complex nature and uncertain environment involving contractors, consultants, clients, suppliers etc. (Masood, 2010).

The success of projects can be depended as meeting goals, objectives, and within budget limits as well as completion of a time. Management of project is mostly based upon tools and techniques which plays important role. Most of the key factors of project management are the management of workers, machines, materials, money and methods etc. Even today late is serious and bringing problem in the construction industry. Despite technological advances and improved understanding of project management by the management concerned is also one cause of delay in project completion. True are various reasons for the delay occurrence such as due to material shortage, equipment failure etc. In some cases delays are interconnected and make the situation more complex. Delay of a project is a main factor and the major cause of construction claims. There is an acute necessity for a detailed investigation to identify the delay factors and choose correct actions to minimize the adverse effects of delays on time, within cost and for a high quality. There is an acute necessity to identify the factors responsible for the reasons of delays, as well as their effects on the Pakistan construction industry.

Lahore is undergoing development on mass scale such as Metro Bus service project, Inter-city flyovers, Lahore Ring Road etc. Current study is an attempt to investigate delay factors, causes and responsibility of construction projects located in vicinity of Lahore. This study helps local and foreign stakeholders to learn about delay risk monitoring and control for success of future projects.

2. Literature Review

Delay is defined as “the time overrun either beyond completion date specified in a contract, or beyond the date that the parties agreed upon for delivery of a project” (Assaf & Al-Hejji, 2006) and “act or event which extends required time to perform or complete work of the contract manifests itself as additional days of work” (Zack, 2003).

Delay is generally acknowledged as the most common, costly, complex and risky Problem encountered in construction projects. Because of the overriding importance of Time for both the owner (in terms of performance) and the contractor (in terms of Money), it is the source of frequent disputes and claims leading to lawsuits. Delays occur in every construction project and the magnitude of these delays varies considerably from project to project. Some projects are only a few days behind Schedule; some are delayed by over a year. So it is essential to define the actual causes of delay in order to minimize and avoid delay in any construction project (S. M. Ahmed, Azhar, S., Kappagantula, P., and Gollapudi, D., 2003). There is a wide range of views on the causes of time delays for engineering and Construction projects. Some are attributed to a single party, others can be ascribed to several quarters, and many relate more to systemic faults or deficiencies rather than to a group or groups (Hancher & Rowings, 1981).

In construction, delay could be defined as the time over run either beyond completion date specified in a contract, or beyond the date that the parties agreed upon for delivery of a project. It is a project slipping over its planned schedule and is considered as common problem in construction projects. To the owner, delay means loss of revenue through lack of production facilities and rent-able space or a dependence on present facilities. In some cases, to the contractor, delay means higher overhead costs because of longer

work period, higher material costs through inflation, and due to labour cost increases. Completing projects on time is an indicator of efficiency, but the construction process is subject to many variables and unpredictable factors, which result from many sources. These sources include the performance of parties, resources availability, environmental conditions, involvement of other parties, and contractual relations. However, it is rare that a project is completed within the specified time. (Assaf & Al-Hejji, 2006).

According to (Alaghbari, Kadir, & Salim, 2007) delays can be categorized in five basic types follows as

- *Excusable Delays* also known as "force majeure" delays, are the third general category of delay. These delays are commonly called "acts of God" because they are not the responsibility or fault of any particular party. Most contracts allow for the contractor to obtain an extension of time for excusable delays, but not additional money.
- *Non-Excusable Delays* are caused by contractors or subcontractors or materials suppliers, through no fault of the owner. The contractor might be entitled to compensation from the delaying subcontractor or supplier, but no compensation is due from the owner. Therefore, non-compensable delays usually result in no additional money and no additional time being granted to the contractor.
- *Compensable Delays* are those that are generally caused by the owner or its agents. The most common form of compensable delay is inadequate drawings and specifications, but compensable delays can also arise from the owner's failure to respond in a timely fashion to request for information or shop drawings, owner's changes in design or materials, and owner's disruption and/or change in the sequence of the work. The contractor is entitled to both additional money and additional time resulting from compensable delays.
- *Non-Compensable Delays* are caused by third parties or incidents beyond the control of both the owner and the contractor. Examples typically include strikes, fires, and acts of government in its sovereign capacity, etc. In this case, the contractor is normally entitled to a time extension but no compensation for delay damages.
- *Concurrent Delays* applied If only one factor is delaying construction, it is usually fairly easy to calculate both the time and money resulting from that single issue. A more complicated – but also more typical – situation is one in which more than one factor delays the project at the same time or in overlapping periods of time.

Previous research study (S. M. Ahmed, Lodhi, S.H., and Farooqui, R.U., 2009) for delay factors in Pakistan, benchmarked the situation in broader aspect and focused on projects in Karachi. According to this study: Major delay categories, in descending order (of criticality), are Design related delays; Finance/ Economic delays; Contract related delays; Construction site related delays; and Sub-contracted work related delays. This is to say that delays due to causes in above categories share a major average (mean) position of importance, while other categories do not have the same average (mean) negative impact on project completion times as the above causes. The most critical causes of delays, in descending order of criticality, are Change orders; Labour productivity issues; Poor site management and supervision; Inspections/ Audits; Poor cost estimation & control; Inadequate project scheduling; Defective design; Inefficient construction methods; Delayed payments; and Incomplete construction drawings. Contractors bear the responsibility for major delays. This is particularly true for equipment related delays, material related delays, labour related delays, construction site related delays, and subcontracted work related delays and management delays. Consultants bear complete responsibility of design related delays. Owners bear complete responsibility of financial/ economic delays as well as contract related delays. This is because payment delays, cash flow issues, contract selection, contract development, contract modifications, change orders are mostly generated at owners' end. Owners also contribute to a lesser significant extent to administrative delays. Government takes its share as a contributory to project delay mostly in terms of administrative and regulatory issues such as changes in laws and regulations, code related delays, law and order issues, and political issues. It is also important to note that Government is a major public owner in Pakistan and hence in case of public projects, where delay is a major concern. Shared responsibility exists mostly in construction site related delays such as work suspensions, issues

with subsurface soil conditions, weather related issues, and acts of God. Lack of technology and material shortage as contributory to delays are also considered as shared responsibility. Although stakeholders in Pakistan are aware of the significance of delay in terms of producing adversarial relationships in a project leading to financial implications, they are not well aware of the concept of formal delay analysis, avoidance and control. The extent of delay analysis and mitigation is limited in the industry: Formal delay analysis and mitigation techniques are not frequently used in the industry.

Identified several delay causes previous research and filtered them with the help of experience personnel. Total fifty three causes were filtered and presented in the questionnaire for data collection. These causes were directly or indirectly related to all the parties of the project i.e. client, consultant, contractor

3. Sampling

The non-probability sampling techniques are useful when there are limited resources, an inability to identify member of the population, and a need to establish the existence of a problem (Scheffe, 1999). Non probability samples that are unrestricted are called convenience sampled (Cooper, 2001) therefor non probability convenience sampling was used because it the cheapest and easiest but quite effective way to conduct the survey. There is freedom to choose whoever is available as long as they had information desired.

4. Survey Instrument – Questionnaire

Prior to data collection process, research instrument in extremely important since it facilities the study direction of the researcher to clarify which are to find out, from whom and how should be developed. Questionnaire is the most effective way to involve a large number of people in the process self-administrated survey of all types typically cost less than the personal interviews (Cooper, 2001) a well-designed questionnaire also motivates the respondent to provide complete and accurate information. Therefore questionnaire mostly was used as a research instrument, which is a structured technique for collecting primary data. The questionnaire mostly composed of closed ended question (dichotomous multiple choices and Likert scale) to address respondents attitudes and perceptions of several effects regarding the factors causing delay in construction projects. The questionnaire divided into five parts: General Information of Respondent; Project Information; All Delay Causes; Effect of Delay; and Recommendation

5. Data Collection

Response rate was significant as survey was successfully conducted on around twenty six (26) construction projects located in Lahore. These projects are diversified in nature as according to type: 44% non-residential projects, 16% residential projects, 16% infrastructure and heavy engineering, 4% industrial, 12% special purpose project and 8% other projects; according to funding 50% were public and 50% privately funded; and cost of projects varies from 10 to 300 Million (Rupees). Respondents' education background was as bachelor's degree (58%), Master degree (31%), doctoral degree (4%), and diploma (7%). They were well experienced as 46% having experience 1 to 5 years, 23 % having experience 5 to 10 years, 19% having experience 10 to 15 years and 2% having more than 20 years' experience.

6. Data Analysis

Collected data was analysed using statistical tool, the questionnaire were processed filtered and entered using spreadsheets and then analysed by applying the basic principles of statistics. In short, data collected was processed into required information by interpreting and understanding the answer from the filled out questionnaire. This method adopted in this study within various groups (i.e. clients, consultants or contractors, project, owner, labours, material, equipment, contingency,). The

five-point scale ranged from 1 (strongly disagree) to 5 (strongly agree) was adopted and transformed to relative importance indices (RII) for each group.
Likert scale: Strong disagree = 1, Disagree = 2, Neutral = 3, Agree = 4 strongly agree = 5
The RII value had a range from 0 to 1 (0 not inclusive), higher the value of RII, more important was the cause or effect of delays. The RII was used to rank (R) the different causes. These rankings made it possible to cross-compare the relative importance method. Following equation used to determine the relative importance index value;

$$\mathbf{RII} = \frac{\sum i*f}{A*N}$$

Where,
RII = relative importance index; I = scale value; F = frequency corresponding to scale value; A = highest scale value i.e. 5 in this case; N = total number of respondents i.e. total frequency in this case

6.1. Ranking of Factors causes Delays

RII for each cause was calculated on maximum scale value of 1 and the highest ranked cause has index of 0.892 while the minimum cause has index 0.569. Top ten causes have index more than 0.762 and selected for further discussion. Some of these causes are interrelated with each other while some are independent. Bar charts are drawn using the ranking data for each group and as well as for overall.

6.1.1. Delay in Payments (0.892): Pay progress payment to the contractor on time because it damages the contractor's ability to finance the work.
6.1.2. Poor weather conditions (0.815): Poor weather condition also delay the project especially in monsoon season the rain intensity and its duration is more which cause delay in construction activities. Even in summer the temperature goes to above 49 Celsius which decreases the productivity of labours and also concreting cannot be done at this temperature.
6.1.3. Less use of highly technology mechanical equipment's (0.800): Pakistan construction is under development process. Due to limited resources the use of highly technology mechanical equipment is not practicing in the field. Old methods and old fashion technology begin continually use in construction projects.
6.1.4. Ineffective planning and scheduling of project (0.792): Planning for most projects will evolve from a high-level plan in the early stages to a very detailed integrated implementation plan during the execution/ construction phase. It is important to realize that a project plan is dynamic. We expect it to change, either due to changing client requirements or owing to strategy changes. Most of the project delays because they have not done properly planning by keeping in mind the contingencies.
6.1.5. Rework due to errors during construction (0.785): Due to lack of experience of contractor and subcontractor error happen during construction which cause delay in the project. Sometime contractor didn't follow the specification to save money when consultant inspection the work they have to do it again which cause delay in project.
6.1.6. Delay due to subcontractor (0.785): While a general contractor has only a few projects in progress at a time, a subcontractor usually has many at a time. A delay in any one of those will likely cause a delay in project. The priority of project may be lower with a given subcontractor because he or she has a number of active projects.
6.1.7. Poor site conditions (0.785): Poor site condition also cause delay in project. Sometime water table of site also create problem for the construction activities. Soil condition are suitable for foundation than other mitigation have to be done which consume the extra time.
6.1.8. Coordination problem with other stakeholders (0.769): Poor coordination among the stakeholders also serious problem which cause delay in construction projects.

6.1.9. Late in reviewing and approving design documents (0.769): Any delay caused by the consultant engineer in checking, reviewing and approving the design submittals prior to construction phase, could delay the progress of the work.
6.1.10. Unclear design details in drawing (0.762): Due to negligence of the consultant unclear design detail in drawing cause delay in construction activities.

There are nine major categories for factors which cause delays as Project related delays (3causes); Owner related delays (5causes); Contractor related delays (7causes); Consultant related delays (4causes); Material related delays (7causes); Labours related delays (6causes); Design related delays (6causes); Equipment related delays (6causes); and Contingency related delays (9causes). Ranking of causes under each category has been done graphically (Figure 1 to 9). Respondents provided opinion about possible effects of delays on projects, refer to figure 10.

6.2. Avoidance of Delay Risk

In respect to avoid risk of delay recommendations from respondents were solicited as follows in ascending order; Project manager capability and experience; Organizational planning; Scope of project should be clear; Motivation of project team; Proper planning and Proper Payment from Client; Prepare Insurance Claims; Good Scheduling Program; Clear contract and accurate bill of quantities; and Compute the amount of Financial Damages.

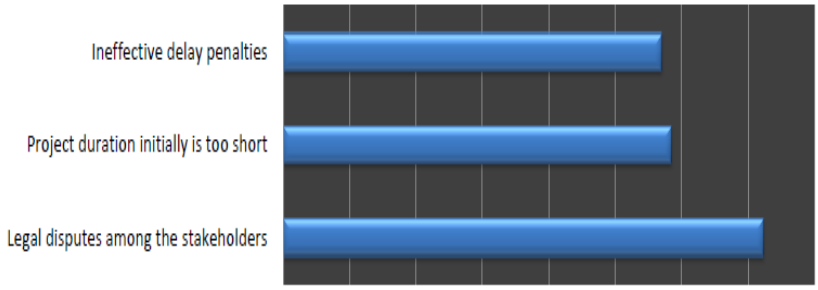

Figure 1: Project Related Delay causes

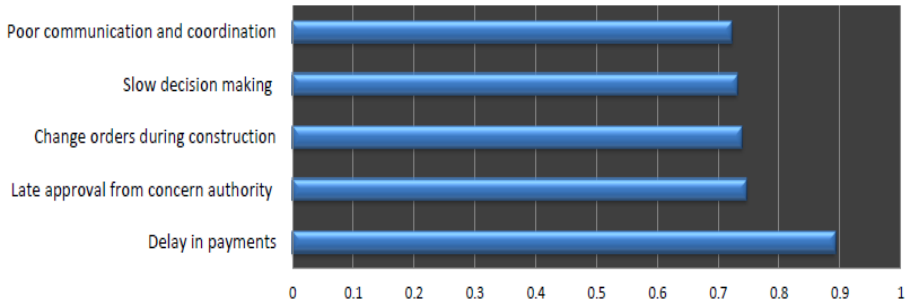

Figure 2: Owner Related Delay causes

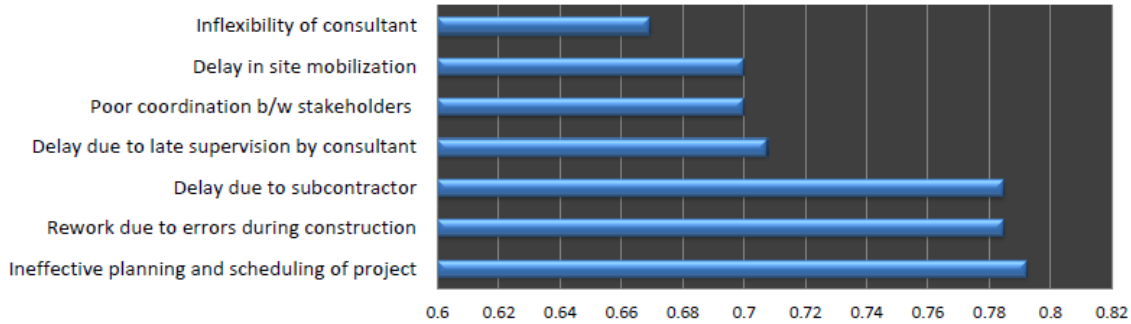

Figure 3: Contractor Related Delay causes

Figure 4: Consultant Related Delay causes

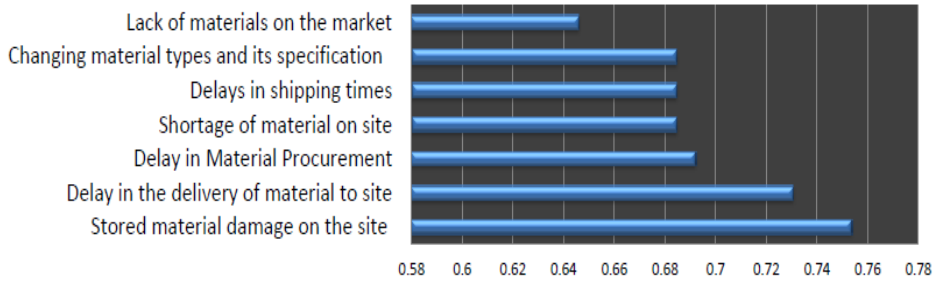

Figure 5: Material Related Delay causes

Figure 6: Equipment Related Delay causes

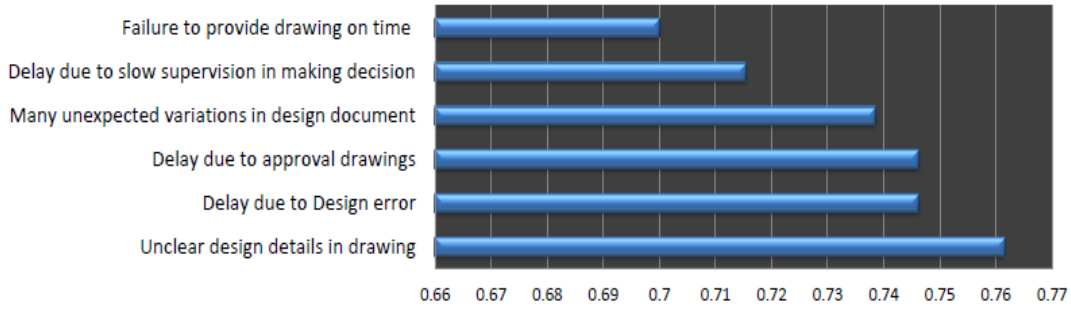

Figure 7: Design Related Delay causes

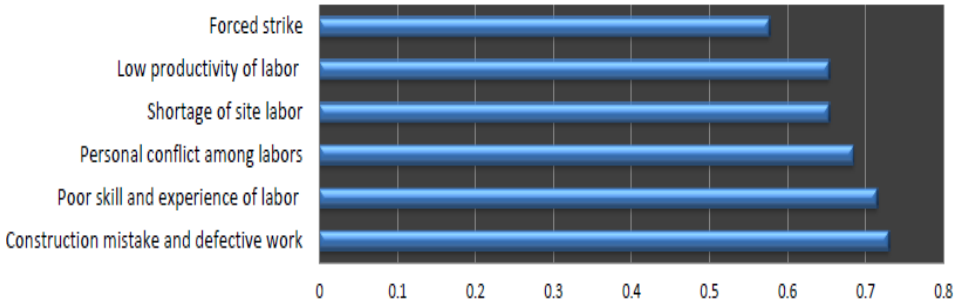

Figure 8: Labour Related Delay causes

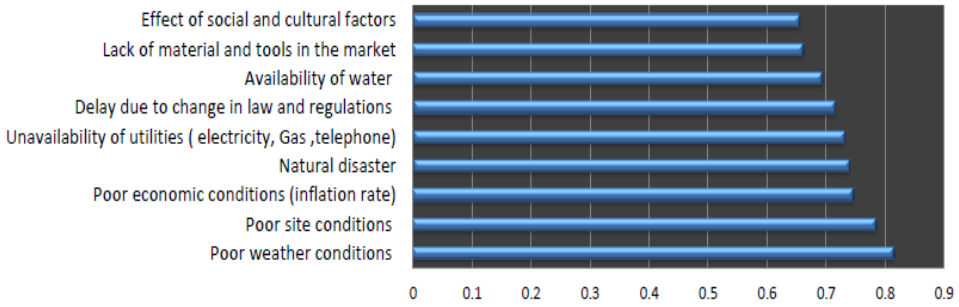

Figure 9: Design Related Delay causes

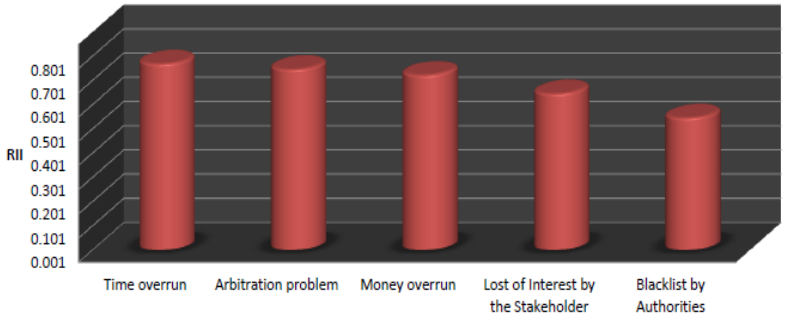

Figure 10: Effects of delay on projects

7. Conclusions

The study identified and ranked the ten most critical delay causes out of selected fifty three. The factors were classified into different phases of construction plus general causes. The result was reliable and match to factors notorious of causing construction delay. It further explored ranked the causes of delay for each group. Furthermore allocation of responsibility done for each group separately as well as for overall factors causing delay in construction project. Implication of this study is valid for projects in Lahore.

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