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Impact of Delays on Cost of Construction Project- A Cross Sectional Study of Pakistani Construction Industry

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ABSTRACT

It is widely believed that construction sector helps developing aggregate economy and reducing unemployment. Currently, Pakistan is experiencing a major transformational phase in the back drop of China-Pakistan Economic Corridor (CPEC). CPEC is valued at US$ 62 Billion. The present study is undertaken to ascertain the impact of time overrun of projects on their cost, the correlation between stakeholders and to predict the effect of delays on cost overruns. Causes of delays are identified by stakeholders of the construction industry of Pakistan. Two models for projects that had delay less and greater than 100 days are developed. Structured questionnaires and personal interviews are carried out to extract primary data for the study. Relative Importance Index (RII) was utilized for ranking of delay causes, and Pearson's correlation to formulate correlation between causes of delays and cost of construction projects from the perspective of client, contractors and consultants. For predicting the impact of delays on cost of projects Linear Regression technique has been used. The results reveal that the causes of delay related to design, procurement and on-site has significant impact on delays. Pearson's result indicates strong covenant between client and contractor. Whereas, there is a weak degree of association between consultant and contractor. Results from linear regression concluded that there is a significant effect of delay on cost of the project.

Keywords: Delay Causes, Relative Importance Index, Pearson's Correlation.

1. INTRODUCTION

Pakistan's construction sector is immensely significant for its aggregate economy's performance and generating employment. It provides substantial employment opportunities. The employment opportunities offshoot because of several in bound and out-bound connections in the national and international set-up [1].

Pakistan is experiencing a major transformational phase in the back drop of CPEC. The CPEC is valued at US$ 62 Billion [2-3]. Keeping this in mind that Pakistan construction sector has an over whelming opportunity in our hands due to the courtesy of our friend China, but there is always another face of the coin. There is an eminent menace that has undermined the performance of the Pakistani construction professionals across the globe, this chronic disease can be referred to as, "delays in construction projects". This problem is turning out to be of a great concern these days since the impact of such delays are borne by all the stakeholders.

The burden of delays is borne by all stakeholders in terms of claims, litigation, cost over-runs, which often than not result in total desertion of the projects. These consequences affect projects in different facets, but the most substantial one is on the overall cost of the project.

The increase in cost results in non-feasibility of the project which in turn makes the project uneconomical for all the stakeholders related to the particular project.

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If this problem persists, it would ultimately pave way for economic crisis the construction industry. The representative causes of delays for Pakistani context can be found from studies such as [2-3].

For successful completion of any project, on time delivery of the project is very important that is under the time, budget and scope restraints, as extensive delays lead to time and cost overruns. This establishes the case to investigate the causes that contribute to delays and monetary over-runs.

This study addresses aforementioned issues highlights the impact of delays in detail unlike the previous studies that neither underline the issues nor suggest any proposition. Although construction undertakings are plagued by delays in Pakistan, none of the predecessor researches have accounted for effects of delay on the costs of a project with a regression model. This study, however, explains the problem areas thoroughly and reveals that delays in the construction projects occur due to many delay causes. The role of stakeholders, ineffective supply of materials, availability and functioning of equipment, and the poor management of labor all contribute to delays and hence result in cost overruns and unsuccessful construction projects. Moreover, while the delays impact the construction projects internally i.e. cost and time wise, it discourages foreign investors that ultimately leads to decline in investments and greatly impacts national progress. This study, therefore, covers many gaps left unaddressed in the previous researches and provides hypothesis for further research.

2. PROBLEM STATEMENT

Krishnamoorthy [4], the World Bank gauged the extent of cost over-run in one of its findings that projects completed worldwide between 1999-2005, the overrun varied between 50-80%. In Pakistan, it contributes 11.48% to GDP against 1.9% of the negative growth and it provides employment to 10% of the nation workforce.

Pakistan's case is no different, very rarely one can quote an example of a project, completed on the time specified or agreed upon. As an established outfall, the projects suffer delay, suspension and worst abandonment [5]. Opting a fire fighting strategy, the delays are mitigated within the schedule or with extension of project's scheduled completion; either way the outcome is cost overrun in both the cases. Delays are attributed to poor management of stakeholders, material, labor and equipment of the project. Supply chain time losses of construction materials is amongst most contributing factors is project's cost overrun and it shadows the performance to an irreparable level so much so that foreign investors are taken aback which culminates into diminishing trend of national development [6].

Any strategy for disease management is sized; based on the extent of the problem. The same understanding holds true for impact of delays (The Disease) on project cost. With this thought, the authors embarked on developing a mathematical relationship that would quantify the impact of delays on project cost. The manuscript is the outcome of such effort.

3. LITERATURE REVIEW

Projects in Pakistan are infamous for their delays and cost overruns. Delays coupled with escalation of project cost overruns have severe repercussions from many aspects not limited to only economic, social and political. Simply stated by [7] delays and cost overruns compromises effectualness of limited economic resources inhibits growth potential and diminish the performance of the economy. Like many other areas, a comprehensive study that is Pakistan centric is absent from secondary literature, apart from this according to [7] there exists an over abundant theoretical and empirical literature of on the subject. We can deduce that delays and cost overruns are generic, and a worldwide occurrence. As discussed, succeeding sub-sections, the core causes, and thus the cures, vary from country to country. Therefore, we can only learn from the international experience and vow to undertake a Pakistan centric study so that we can adapt to tested solutions and not just blindly adopt them.

3.1 Causes of Delays

Refer Table 1 for exhaustive summary of the major causes of delays as identified in secondary literature.

Upon going through the extensive list of delay causes, the research team classified the respective causes in major classification to consolidate the analysis efforts. The category of the delay causes that is included in the study are: (1) Stakeholders; (2) Design; (3) Procurement of Machinery and Manpower; (4) On-site Causes and (5) External Causes. The causes of delays and its respective classification can be referred from Table 2.

TABLE 1: MAJOR DELAY CAUSES HIGHLIGHTED IN SECONDARY LITERATURE

No.	Origin of Study-Study Reference-Major Causes of Delay
1.	Pakistan [9] 1. Finance and payments 2. Inaccurate time estimation 3. Quality of material 4. Delay in payments to supplier and subcontractor 5. Poor site management 6. Natural disasters 7. Unforeseen site conditions 8. Shortage of material 9. Delays caused by subcontractors 10. Changes in drawings 11. Improper equipment 12. Inaccurate cost estimation 13. Change orders 14. Organizational changes 15. Regulatory changes
2.	Tanzania [10] 1. Design changes 2. Delays in payment to contractors 3. Information delays 4. Funding problems 5. Poor project management 6. Disagreement on the valuation of work done
3.	Nigeria [11] 1. Youth unrest, militancy and communal crises 2. Inadequate planning by the contractors 3. Delay or non-payment of compensation to the communities 4. Wrong choice of consultants and contractors by the clients 5. Weather condition; poor contract management by the consultants 6. Late identification and resolution of drawings and specification errors and omissions by the consultants 7. Poor contract management by the consultants 8. Inappropriate design by the consultants 9. Unrealistic contract duration by the clients 10. Poor coordination of subcontractors by the contractors
4.	Singapore [12] 1. Delay in progress payment by owner 2. Adverse weather conditions 3. Main contractor financial problems 4. Evaluation of completed works
5.	Malaysia [13] 1. Weather conditions 2. Poor site conditions 3. Poor site management 4. Financial problems 5. Contract modifications 6. Delay in approving of major variations 7. Contractor coordination lapse with other parties 8. Construction mistakes and defective works
6.	Ghana [14] 1. Delay in honoring certificates 2. Underestimation of the cost of project 3. Underestimation of complexity of project 4. Difficulty in accessing bank credit 5. Poor supervision 6. Underestimation of time for completion of projects by contractors 7. Shortage of materials 8. Poor professional management 9. Fluctuation of prices/rising cost of materials 10. Poor site management
7.	Afghanistan [15] 1. Corruption 2. Poor qualification of the contractor's technical staff 3. Payment delays by clients 4. Poor site management and supervision by contractor
8.	Dubai [16] 1. Unrealistic project duration 2. Nominated sub-contractors 3. Culture impacts
9.	Uganda [17] 1. Change of work scope 2. Delayed payments 3. Poor monitoring and control 4. High cost of capital 5. Political instability/insecurity.

Table 2: Categorization of Causes of Delays

Category	Causes of Delays
Stakeholders	Finance and payment of completed work, Unrealistic imposed contract duration, Subcontractors, Site management, Improper planning, and Contract management.
Design	Delay in approving major changes in the scope of work by consultant, Complexity of project design, Design changes by client or his agent, Design errors made by designers
Procurement of Machinery and Manpower	Inadequate cash flow, due to non-payment, Obsolete technology, Equipment allocation problem, Shortage of equipment, Low productivity of labour, Unqualified / inadequate experienced labour, Changes in material types and specifications during construction, Damage of materials (Wear & Tear), Late delivery of materials, Shortage of construction materials, Change/Variation orders
On-site Factors	Delay in performing inspection and testing, Rework due to errors, Poor site management and supervision, Inappropriate construction methods, Accidents during construction
External Factors	Conflict, war, and discontentment from the general public, Unfavorable weather conditions, Delay in providing services from utilities (such as water, electricity), Natural disasters (flood, hurricane, earthquake), Price fluctuations, Delay in obtaining permits from municipality.

3.2 Delays Causing Cost Overrun

Delays cause cost overruns can be understood by simple causal relationship, delays mean extra days of work (unaccounted previously), extra days mean more man-machine hours be deployed for project

completion. Consequently, additional labor, machine and equipment cost is required, which ultimately lead to escalation in project cost [6].

In a study carried out by [18], the learned authors claim that in Nigeria, the predominant causes influencing cost overruns are materials cost inflation, inaccurate quantity estimation and project complexity.

An undertaking by [19] identified 26 causes of cost overrun in the construction of Ground Water Project in Ghana. The results were based on a questionnaire feedback from a targeted audience of 55 clients, 40 contractors and 30 consultants. According to the contractors' and consultants' opinion, payment lag was the most important cost overruns factor, while clients ranked poor contractor management as the most important factor.

4. RESEARCH GAP AND CONTRIBUTION

Construction delay occurs "when a project is executed later than intended planned, or particular period or later than specific time that all the concerned parties agreed for construction project" [10]. Apart from sparingly distributed research over a prolong time period, there is negligible research available on the perception of key participants of construction industry in Pakistan. This has prompted the interest of this research to fill the research gap. As highlighted earlier that in order to come up with feasible indigenous solutions, Pakistan centric study is needed. Keeping that undertaking in mind, this research study addresses the problem of 'delay causes' and 'impact relationship' between delays and cost of the project and develop a model that quantify the impact of delays on project cost. This is perceived vital to any efforts planned for eradication of this disease.

5. SCOPE AND LIMITATIONS

The primary data for the study is collected from building construction projects based in Karachi due to human and time resource constraints. Furthermore, the study is limited to the perception-based investigation of local key players.

6. OBJECTIVES

The objective of the research study focuses on the following:

(a) To ascertain delays causes in construction projects and rank them on the basis of occurrence in construction projects.
(b) To analyze the relation between client, consultants and contractor for the delay causes identified.
(c) Development of prediction models to quantify impact of delays on project cost.

7. METHODOLOGY

The methodology flow chart is summarized in Fig. 1.

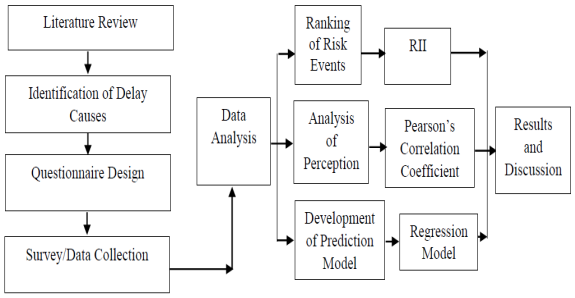

Fig. 1: Methodology Flow Chart

7.1 Methodology Description

The general methodology of the study was divided into two phases. Phase-I comprises of Steps "a-d"; whereas Phase-II comprises of steps "e-g" respectively.

(a) Secondary Literature review on Delays and Cost Overruns in Construction Industry, especially in Pakistan (Phase-I).
(b) Identification of delay causes from research papers (Phase-I).
(c) Categorization of these causes according to their type; Stakeholders, Design, Procurement of Machinery and Manpower, On-site and External factors etc. for questionnaire development (Phase-I).
(d) Distribution of questionnaire to the representatives of Clients, Contractors and Consultants' organizations, to get the perception on frequency of delay causes for survey (Phase-I).
(e) Ranking of the causes of delays using Likert Scale (Phase-II).

(f) Pearson's Correlation Method to find the correlation between the client, consultant and contractor ranking (Phase-II).
(g) Development of Linear Regression Model for study of effects of delays on Cost of a project (Phase-II).

7.2 Data Collection

Similar studies for various construction industries have been conducted in the past. The authors of this study banked on the established and tested methodology in the secondary literature hence this study employed research design by an earlier study conducted in Nigeria [18]. The respondents of this study were clients, contractors and consultants from all over Karachi city. Data collection included two main sources of data:

7.2.1 Secondary Data

Secondary data was collected through previous research papers. This included the identification of Delay causes, enlisting of Delay factors and categorization of these causes into different heads. There were a total of 163 major causes that were identified from literature review.

7.2.2 Primary Data

Primary data was acquired via questionnaires and interviews similarly on the lines of [18]. This provided the perception of the representatives of main stakeholders regarding the frequency or recurrence of causes of delays in a construction project based on Likert's 5-point scale.

Data points for Linear Regression Model were collected from a total of sixteen (16) construction projects by different firms (names of companies have been kept confidential)). This included their Bill of Quantity (BOQ), Variation Orders, Planning Schedule and Implemented schedule. There is an over abundant secondary literature that suggest usage of Regression Models to predict project cost and duration [21-22]. Keeping in view the suitable of application of regression models to predict project parameters, the authors decided to employ the same technique. This strategy is also valid from the point of conducting research for Pakistani construction industry.

7.3 Questionnaire Design

Questionnaires were developed into two (2) major parts; A and B as follows:

- Part-A: Personal information
- Part-B: Designed to acquire perception about causes of time delays in construction projects. A total of 60 delay causes were extracted from [23].

7.4 Questionnaire Distribution and Collection

Personal interviews were administered in which respondents were asked to rank and score causes according to their experience about their frequency and occurrence. To maintain uniformity, a minimum of thirty-one (31) respondents were selected from each of the three (3) stakeholders; Clients, Contractors and Consultants. Over a period of four (4) months, a total of 120 Questionnaires were distributed while only 97 valid responses were returned. Only 93 questionnaires were used for analysis for equal representation from each stakeholder. Table 3 shows the overall response rate from stakeholders for Questionnaire survey.

Table 3: Response Rate

Stakeholder	Questionnaires Distributed	Valid Questionnaires Received	Response Rate (%)
Clients	40	31	77.5
Contractors	40	34	85.0
Consultants	40	32	80
Total:	120	97	80.83

Table 3 shows that the response rate is 80.83%, which is acceptable for a Questionnaire survey and is not considered biased according to [25]. Yet, such response rate shows that the Pakistani construction industry is in need of awareness of the importance of such development studies.

8. DATA ANALYSIS AND RESULTS

The succeeding sections and sub-sections elaborate on the results and discussion based on the data collected. Furthermore, the ranking according to the stakeholders and different categories will be discussed, analysis of perception will be presented and a linear regression model for analyzing the impact of delays on cost of a construction project will be presented. Lastly, a case study will be analyzed to predict the impact of delays on future cost of the construction project.

8.1 Description of Data

The data was collected by random sampling method among the Clients, Consultants and Contractors. 31 Questionnaires each were filled by representatives of these three stakeholders. The delay causes are rated on their frequency of occurrence on the Likert's 5-point scale.

8.2 Ranking of Delay Causes

All 60 delay causes were rated by representatives of stakeholders during the questionnaire survey and were ranked using RII. Tables 4-8 encapsulates the ranking of causes of delay on RII in ascending order; highest ranked factor on the top and the factor which is least ranked is placed at last.

8.2.1 Ranking of Delay Causes Related to Stakeholders

Table 4 shows the ranking of delay causes by different categories of Stakeholders as analyzed by RII. This shows that the stakeholders tend to rank causes related to contractor rather relatively higher. The most highlighted factor related to stakeholder category is inadequate contractor experience and the least highlighted factor is inadequate definition of substantial completion.

Table 4: Ranking of Delay Causes related to Stakeholders

Rank	Delay Cause Description	ORII (%)	Weighted Average
1	Inadequate contractor experience	69.677	3.483
2	Slowness in decision making	68.387	3.400
3	Poor communication and coordination with other parties	67.527	3.376
3	Lack of incentives for contractor to finish ahead of schedule	67.527	3.376
5	Original contract duration is short	66.237	3.312

8.2.2 Ranking of Delay Causes Related to Design

Table 5 shows the ranking of delay causes in the category of design as analyzed by RII. These causes were found to be the highest ranked causes in Overall Relative Importance Index (ORII) of all the causes. ORII has been used to rank factors influencing a project parameter. Some of the notable examples that can be quoted are as follows. ORII was used in one study to rank delay factors in construction projects after Egyptian revolution [21]; In another study conducted for Egyptian Construction Industry, the author used ORII to rank factors causing cost variation for wastewater projects; In one study conducted in 2016 for Egyptian construction industry, the learned authors used ORII to rank delay causes in road construction projects [22-24]. Each of the stakeholders ranked Design changes to be the most recurring factor for delays in a project. The most highlighted factor in this category is design changes by client or his agent during construction and the least highlighted factor is complexity of project design.

Table 5: Ranking of Delay Causes related to Design

Rank	Delay Cause Description	ORII (%)	Weighted Average
1	Design changes by client or his agent during construction	80.000	4.000
2	Ineffective project planning and scheduling	77.634	3.882
3	Design errors made by designers	76.559	3.828
4	Delay in approving major changes in the scope of work by consultant	72.473	3.624
5	Misunderstanding of client requirements by design engineer	63.441	3.172

8.2.3 Ranking of Delay Causes Related to Procurement

Table 6 shows the ranking of delay causes in the category of Procurement as analyzed by RII. Procurement has been important and higher ranked according to the Clients. Change orders though result from either design changes or specification changes, but affect the procurement of finances, material and labor. Thus, they are ranked higher. The least highlighted factor in this category is personal conflicts among labor.

Table 6: Ranking of Delay Causes Related to Procurement

Rank	Delay Cause Description	ORII (%)	Weighted Average
1	Change orders	78.495	3.925
2	Incompetent project team	76.774	2.828
3	Shortage of construction materials	73.118	3.656
4	Changes in material types and specifications during construction	71.828	3.591
5	Late delivery of materials	70.753	3.538

8.2.4 Ranking of Delay Causes Related to External Factors

Table 7 shows the ranking of delay causes in the category of external factors, as analyzed by RII. External factors are not in control of either of the stakeholders and therefore have been ranked rather low by them. The most highlighted causes in this category is delay in performing final inspection and certification by a third party and the least highlighted factor in this category is global financial crisis.

Table 7: Ranking of Delay Causes Related to External Factors

Rank	Delay Cause Description	ORII (%)	Weighted Average
1	Delay in performing final inspection and certification by a third party	70.323	3.516
2	Delay in obtaining permits from municipality	61.290	3.065
3	Conflict, war, and discontentment from the general public	59.355	2.968
4	Accidents during construction	57.419	2.871
5	Unfavorable weather conditions	56.129	2.806

8.2.5 Ranking of Delay Causes Related to On-Site Factors

Table 8 shows the ranking of delay causes in the category of On-Site as analyzed by RII. On-site factors have been important and higher ranked according to the contractor. Poor site management is the only factor that is ranked high in frequency. The least highlighted factor in this category is rework due to errors.

Table 8: Ranking of Delay Causes Related to On-Site Factors

Rank	Delay Cause Description	ORII (%)	Weighted Average
1	Poor site management and supervision	75.054	3.753
2	Inappropriate construction methods	70.753	3.538
3	Inaccurate site investigation	66.021	3.301
4	Delay in performing inspection and testing	56.559	2.828
5	Rework due to errors	52.688	2.634

8.3 Pearson's Correlation Result

Ranking of each of the delay causes were calculated using Relative importance index method. In order to develop a relation between the responses of stakeholders Pearson Correlation technique is used and the result generated in Table 9.

From the analysis of the received responses (refer Table 9), it can be inferred that, if the delay causes related to "Design" and "Onsite Factors" Category are kept in purview then, the clients and contractors are on the same page as indicated by the "Very High" level of agreement between their responses. Whereas, Clients and Consultants' responses converge to strong agreement for "Design" related causes. However, the study did not able to single out any specific category of factors amongst Consultants and Contractors.

8.4 Linear Regression Model

To determine the effect of delays on the overall cost of the project, regression analysis is used and the data was split into two categories which are as follows.

(i) Which had delays less than 100 days.
(ii) Which had more than 100 days' delay ranging up to 1185 days.

8.4.1 Assumptions

The assumptions incorporated for this analysis are:

(a) Data is normally distributed i.e. the data is symmetric.
(b) All other delay causes which might have increased the cost of the project other than delays were neglected.

8.4.2 Criteria

For a particular regression equation to be applied; it must satisfy certain criteria:
For accurate results, we devised one model for each data set, as combining them into one model would not have produced desired results.

(a) Multiple R is the correlation coefficient. It shows the linear relationship between two variables. The value is 1 for variables with perfect positive relationship and 0, if there is no relationship between two variables.
(b) R^2 shows how close the data are to the fitted regression line. It is also known as the coefficient of determination. It tells how many points fall on the regression line.
(c) P-value indicates that how confident a researcher

Table 9: Correlation and Qualitative Strength of Agreement between Stakeholders						
Category	Correlation Between					
	Contractor and Client		Client and Consultant		Consultant and Contractor	
	R-Value	*Strength of Agreement	R-Value	*Strength of Agreement	R-Value	*Strength of Agreement
Stakeholders	0.442	Low	0.511	Moderate	0.628	Moderate
Design	0.927	Very High	0.965	Very High	0.867	High
Procurement	0.843	High	0.726	High	0.883	High
External Factors	0.846	High	0.843	High	0.793	High
Onsite Factors	0.911	Very High	0.818	High	0.674	Moderate
*The strength of agreement has been interpreted from [25] cited by [26].						

can be that independent variable has some correlation with the dependent variable. P-value is compared to the α-value set initially for analysis. In our case, α-value was taken as 0.05 which means confidence level = 95%. For analysis to be significant, P-value should be less than or equal to α.

For accurate results, we devised one model for each data set, as combining them into one model would not have produced desired results.

8.4.3 Results for Model-I

Table 10 summarizes the information for the calculation of Liner Regression Analysis. Regression statistics are shown in Table 10.

Table 10: Regression Statistics for Model-I				
Regression Statistics		Intercept	X-variable	Regression Equation
Multiple R	0.927	-	-	$Y = 4.509X^{0.654}$
R Square	0.859	-	-	
Adjusted R Square	0.824	-	-	
Standard Error	0.188	0.189	0.132	
Observations	6			
P-value	-	1.84E-05	0.008	
Coefficients	-	4.509	0.654	

Fig. 2 is the interpretation of Model-I (data set comprises of projects which were having delay less than 100 days in the overall project) regression equation, the interpretation is developed by plotting the regression equation against the simulated days (0-100 days). Very short-lived slow growth of cost variability can be observed (early simulation days), the cost variability gradually increases as the simulated days' progress indicating loss of cost control and other project management functions.

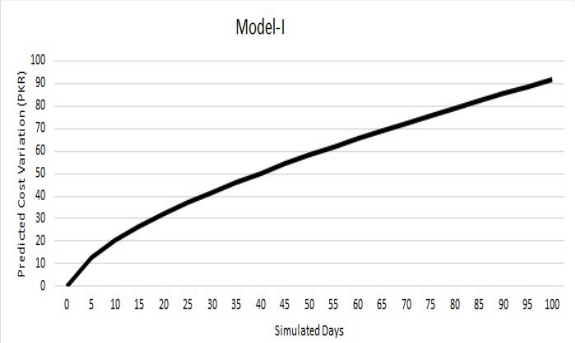

Fig. 2: Interpretation of Model-I Regression Equation

8.4.4 Results for Model-II

Regression statistics are shown in Table 11.

Table 11: Regression Statistics for Model-II				
Regression Statistics		Intercept	X-variable	Regression Equation
Multiple R	0.731	-	-	$Y=2.46 X^{1.89}$
R Square	0.534	-	-	
Adjusted R Square	0.476	-	-	
Standard Error	0.691	1.598	0.627	
Observations	10	-	-	
P-value	-	0.016	0.016	
Coefficients	-	2.465	1.99	

The results from the data set are satisfactory as the Multiple R value is 0.73, which establishes strong affiliation between the two variables, also the P-value is less than 1. And, R^2 value is 0.53 which shows that 53% variation is covered.

Fig. 3 is the interpretation of Model-II (data set comprises of projects which were having delays more than 100 days in the overall project) regression equation, the interpretation is developed by plotting the regression equation against the simulated days

(100-1000 days). Except from the initial slow growth of the cost variability, the cost variability gradually drastically increases as the simulated days' progress indicating loss of cost control and other project management control functions.

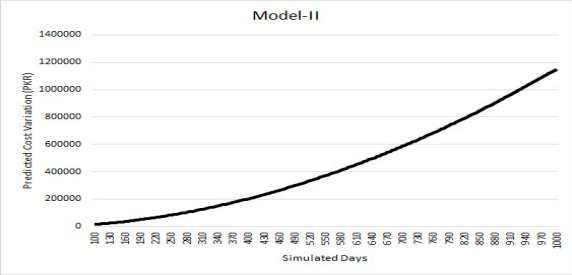

FIG. 3: INTERPRETATION OF MODEL-I REGRESSION EQUATION

9. CONCLUSIONS

Construction delays in Pakistan are explained through secondary literature review and primary data collection from field survey. Through in-depth literature review, 60 causes of delay were shortlisted to address the problem of delays in construction projects of Pakistan, the causes were then categorized into five groups. Three major stakeholders, including 31 clients, 31 contractors and 31 consultants responded to the questionnaires. On the basis of the ranking of causes, most significant and the least prominent delay causes were identified. The ranking of the causes according to the level of their importance on delay was done by using RII and the most significant and least significant causes were identified. Weighted average mean method was used to determine delay causes that were most commonly identified on average basis by the respondents.

(i) This study concludes that the delay causes such as Design changes by client or his agent during construction, change orders, Ineffective project planning and scheduling are most critical in causing delays. Personal conflicts among labor, compensation delays to affected property owners and global financial crisis were identified to be least critical in terms of frequency in causing delays on the basis of RII.

(ii) Almost same results were achieved through weighted average mean method although the two methods are not related to each other. This verifies that the delay causes identified through RII are indeed most and least critical.

(iii) Strength of relationship between stakeholders was analyzed through Pearson's correlation method. It is concluded that there is a strong degree of agreement between client and contractor over different delay causes. Whereas, the weakest degree of agreement was found between consultant and contractor. This is because the contractor is responsible for execution of the project, and it is an entirely different field as compared to other aspects of the construction projects as compared to consultants', also it takes the longest time in an overall time frame of the project, therefore contractor feels that the consultant is most responsible for the delays. Designing and execution are different phases of a project which exists in completely different time frames therefore; there is a weak relationship between stakeholders responsible for these two phases.

10. RECOMMENDATIONS

Design, procurement and on-site categories were found to be most critical in terms of delay. Following recommendations could be incorporated to minimize the effects of delays on construction projects:

(i) Consultation should be done with the architect, consultant engineer and planner before execution of the work.

(ii) To avoid ineffective planning and scheduling, project manager should do some investigation regarding budget to identify all unfavorable conditions that hinders the progress of the project.

(iii) Rework due to errors can be minimized by hiring competent and experienced contractor and consultant.

(iv) Change order during procurement is one of the major causes of delays. It can be minimized by maintaining strong communication between all the stakeholders involved in the project.

(v) Shortage and late deliveries can be controlled by accurate estimation of the quantity and time of the delivery of material.

(vi) Poor site management and supervision is a major cause of delay and it can be minimized by hiring

trained management team having expertise to supervise work well.

11. FUTURE WORK RECOMMENDATIONS

Delays and cost overruns is a vast subject which has a substantial influence on the construction industry. Many studies and explorations could be carried out in this extent to overcome the negative impact of delays. Following recommendations could be adopted for future research on this study:

(i) The main problem faced during the research was of data collection because like any other industry, construction industry is also very sensitive, secretive and possessive in terms of sharing project data. To achieve the milestone, key persons from industry who are capable of providing real time data from previous completed project should be consulted and taken in into confidence.
(ii) Data sets used were limited in number. For developing better and more accurate results more data points can be incorporated for analysis.
(iii) Cost variation could also be calculated based on types of delays so that relation can be developed for different delay scenarios.
(iv) The scope of the study was limited to building construction projects. It can also be widened by considering different categories of projects e.g. Infrastructure, Residential, Welfare and Recreational etc.
(v) Instead of considering only Karachi city, the research could be applied on national level.

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