Why Are Triple Constraints Always Challenged? : Evidence From Construction Projects

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Abstract: The construction industry plays a significant job in the nation's economic growth. All projects run under three constraints: time, cost, and scope. Constraints are called triple constraints. Challenges faced by Triple Constraints are major reason for the lag in the Construction Projects. This research study aims at exploring reasons for the challenges Triple Constraints are facing in the construction Industry. Construction (Building) projects at Karachi, Pakistan were initiated by the Government in 2016 and still they are facing problems to complete the Projects according to the Actual Project Duration and the Originally Estimated Cost for the Projects. The data was collected of two types; Primary data and Secondary data, Primary data from the Ongoing Construction Projects in Karachi and Secondary data was collected from the Research papers. Study of research papers highlighted reasons for the Triple Constraint delays/overruns. These reasons were input into NVivo software to determine the frequency of each cause. The reasons were ranked on the basis of Relative Frequency Index (RFI), Relative Severity Index (RSI) and Independent Relative Importance Index (IRII) through research papers. Some of the causes which were identified were "Underestimating effects of Inflation and Escalation, Poor Planning and Scheduling, Clients-Slow decisions, Design changes, Poor Financial Management and etc. are the top reasons behind delays and project failure of Construction projects. These results would provide help for Clients, Contractor and Consultant in improved planning and mitigating the effects of lag in the future Construction projects.

Index Terms: Triple constraints, construction projects, project failure, nvivo software.

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1. INTRODUCTION
The construction industry plays a significant job in the nation's economic growth [1] and plays a major impact on economy of all nations [2]. The progress of construction industry commits to Gross Domestic Product and job in all countries, which has a doubling effect on different industries, for example, manufacturing, professional administrations and financial administrations [3]. Construction projects include construction fill in as well as all planning, structure, management, implementation or other work up to the finish of construction period. The construction project becomes successful if project is well pre-planned for the cost, meets all requirements on schedule and within the scope of the project [4]. All projects run under three constraints: time, cost, and scope. Constraints are commonly called triple constraints and are spoken to as a triangle, as appeared in figure – 1. These three constraints are important in any undertaking. Triple constraints are a balance of undertaking cost, time, and degree. It was utilized to determine if the project goals were achieved. From a project management viewpoint, the manager's responsibility is to accomplish the construction project based upon cost, scope and time constraints [5]. Most projects spend exceeding time and cost pressure cannot meet the project's expectations, so project manager has to be responsible for preventing it.

Figure 1: triple constraints of project management [6]

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Triple Constraints are key ingredients to Project Management; even fulfilling all other tasks of Project Management without Triple Constraints will result in failure of Project [7].Some projects aren't achieved within planned constraints. The main reasons why a project has failed is the inability to identify, monitor, manage and manage project risks. This may have been reduced by using a monitoring and feedback system [8].Typically, every day household activity is characterized by a definite deadline, i.e. start time and end time, for achieving a specific purpose by disposing of a specific amount of assets. The characteristics are called project constraints. Everyday activities are unrecognizable because they are small in size, acquainted, repetitive, continuous, and usually adept by single individual [9].The construction industry is constantly modifying, and organizations that neglect to adjust and react to the multifaceted nature of the new condition will in general experience endurance issues [10]. This Research is proposed to address the significant reasons for time, cost and scope failure in construction (building) projects.

1.1 Aim and Research Questions

Q1: How triple constraints affect building projects?

Q2: What challenges are faced by organization in order to mitigate these constraints?

2 LITERATURE REVIEW

2.1 Triple Constraints
Except for customer satisfaction requirements, projects are limited in scope, time and cost, commonly known as "Triple constraints" [12]. Scope: The scope for a triple constraint can be defined as follows: What happens as part of the project? What unique services do customers expect from the project? Scope is used to specify the qualitative and quantitative elements of task to achieve its goals. Typically, the scope of work is partitioned into lesser, increasingly sensible charge utilizing work characterization structure strategies. In view of the author's work understanding, the work scope is evaluated to have three segments: Quality, specs, standards to

100

accomplish [12]. Cost: The cost in terms of triple constraints can be defined as: How much does it take to finish a project? What is project budget? The second factor of triple constraint is cost. Project cost refers to the assets that should be enforced or designated to an undertaking to achieve the recommended scope of work [12]. Time: Last time can be defined with reference to triple constraints. In how much time does a project finishes? What is schedule [12]? The third factor of triple constraint, time, is described as the estimated actual duration to execute and finish the workspace. There are two elements. Scheduling and schedule control [13]. Project Management Triangle is a valuable miniature to outline effect of triple constraints of progress on key task members. The triangle mirrors the way that the 3 limitations are linked and include tradeoffs-one side of the triangle can't be replaced without influencing other. Task quality is established in each of the 3 factors and is afflicted by the equalization of the 3 elements [13], [14]. Thus, triple constraints are defined as an important project management concept that mirrors a structure for assessing contending requirements [15].

2.2. Relationships between the Triple Constraints

Constraints restrict or direct project team actions [16]. Unexpected situations can cause any of triple imperative components, scope, time, or cost to differ from beginning arrangement. Therefore, the trade-off of triple constraints requires careful and appropriate planning. It is statistics that construction projects were not performed as decided. Among more things, construction projects are conducted in open environments, above and below the ground, exposing them to environmental impacts and the complexity of the geological structure. An experienced project manager knows that the project would go as decided, but does not know how to differ [17]. Therefore, keep in mind that a construction project requires regular modification of triple constraints throughout project period to successfully complete project. To ensure project completion, at least one variable triple constraint must be changed to give the premise to extend arranging [18]. The trade-off act inherent in triple constraint variables of scope (S), time (T), and cost (C) can be explained by 3 main relationships [41]: Relationship 1, S ↑ αT ↑ C ↑. This indicates that scope targets provided at amount of time and / or cost targets. Relationship 2, T ↓ αS ↓ C ↑. This means that duration goals provided at the amount of scope and / or cost goals. Relationship 3, C ↓ αS ↓ T ↑. This means you can achieve your cost goals at amount of scope and time goals. Where the arrow-up ↑ suggests an increase and the arrow-down ↓ suggests a decreaseProjects have different challenges because they are unique and former efforts. Some projects are scope driven, some are time driven, and some are cost driven. The following are measures of the relationship between impact level and triple constraint [19].

2.3 Construction Projects

The construction part and construction exercises are viewed as one of the principle sources of monetary development, improvement and financial action. The construction industry helps in boosting and developing country's economy. This is viewed as a mechanism for creating employment and providing job opportunities for many workers. It plays an important role in developing revenue in both formal and informal divisions. This complements foreign exchange revenues from construction materials and engineering

services transactions [20]. A construction project can be considered rewarding when the project is completed on time with the appropriate technical outcomes or quality within the budget [21]. Construction is a dynamic and different field, thus fragmented. Effective communication is critical to the success of performance goals (productivity, profitability, and repetitive work opportunities) [22]. The construction industry is one of India's main economic industries and major driver of India's national economy. However, there are a lot of issues that impact time, cost, and quality performance. Successful management of construction projects depends on three principle factors: time, cost and quality. Effective finishing of a construction projects inside an assigned time period has become the most important and compensating work for supervisors, designers, architects and contractual workers [23].

2.4 Research Model

The Research model for this research is given below:

$$Q = T + C + S \text{ [6]}.$$

Where,
Q = Quality
T = Time
C = Cost
S = Scope
Q depends on C, T and S. This means you can achieve your Quality by maintaining the cost, time and scope of the project [6].

3 RESEARCH METHODOLOGY

Research is about issues developed in construction projects, and research questions are based to investigate the factors that challenges triple constraints (Scope, time and Cost). This chapter gives the complete details of how the study is to be transferred out from data collection to its analysis. The methodology of the research consists of seven (7) stages; the first stage studies the literature review of the challenges triple constraints faced during construction. The second stage of the research analyses the problems and causes of triple constraints in the construction period. The third stage of the research provides evidence from the ongoing construction projects. The fourth phase of the research is to go through the research papers and then to input them in NVivo software to identify the frequency of number of coding reference and number of sources of the problem and causes which challenge triple constraints [24]. The fifth stage of the research is focused on the statistical analysis of the results from NVivo analysis which are input in the formulation of RFI, RSI and IRII to identify the Relative frequency Index, Relative Severity Index and Independent Relative Important Index and interpretation with the help of given formula below [25-31]. The sixth stage of this research analyses data and give out the results. The seventh stage of this research provides the conclusion and future research regarding the objectives of the study [31].

Following mathematical models are used [25-31];

1. $$RFI = \frac{\Sigma f_i}{a} \times n$$

101

2.
$$RSI = \frac{\Sigma s_i}{a} \times n$$

3.
$$IRII = \frac{\Sigma(f_i \times s_i)}{a} \times n$$

Where,
RFI= Relative frequency Index, RSI= Relative Severity Index, IRII= Independent Relative Important Index, f_i = Frequencies, s_i = Severities, a = Large Amount of Scope and n = Number of Research Paper

3.1 Phase 1: Data Collection

Two different types of data are acquired which are;

Primary Data:
Primary Data is to be acquired from the Ongoing Construction Projects in Karachi, Pakistan, that are facing Delay in the Time, Cost and Scope of the projects. The data is collected from visiting the higher authorities of the two (2) ongoing Projects namely, "Construction of Sindh Parliamentarians, Karachi" and "Extension/ Construction of Indus Hospital, Korangi Creek, Karachi". The Planned Cost and Time of the Project was then determined, after that the expected Time and Cost which will be at the completion of the project was determined. From both determinations, the Time and Cost exceeded was determined. The problems/causes were determined which causes the triple constraints to overrun in the following projects [31].

Secondary Data:
It includes the review of research papers of triple constraints been challenged. The Problems and Causes are identified, the Research papers are input in the NVivo Software which gives out the frequency and percentage of the problems and causes during the Construction period in the research papers been studied.

3.2   Phase 2: Evidemce from the Ongoing projects in Karachi, Pakistan.
These are the evidences from the ongoing projects in Karachi

Table 1: Evidence from the Ongoing Projects in Karachi

	Construction of Sindh Parliamentarian Residences, Karachi	Extension/Construction of Indus Hospital, Korangi Creek, Karachi
Date of Commencement (as per Contract)	15th August 2016	1st October 2016
Date of Completion (as per Contract)	15th August 2018	1st October 2018
Extended Date (Expected)	30th June 2020	30th September 2020
Project Cost (Original)	2261 Million	2269 Million
Project Cost (Revised)	2397 Million	2569 Million
Reasons	Late mobilization, Land sliding etc.	Design change from Conventional Slab to Flat Slab System

4   RESULTS
This Research shows the results of both Qualitative and Statistical Analysis done to define the Problems and Causes of the Triple Constraints facing during Construction Period. The problems and causes were identified from the research papers and from the two (2) ongoing Construction Projects in Karachi that were facing Time, Cost and Scope Overruns in the Projects. The results were compared and then inserted into NVivo Software to get the frequency of the Problems and Causes. Fifty three (53) main problems were identified. Statistical Analysis was done to determine the Relative Frequency Index (RFI), Relative Severity Index (RSI) and Independent Relative Important Index (IRII) of each cause. The main cause that was on the top was "Clients-slow Decision Making" as it was having the frequency of Fifteen (15) amongst the 53 Delay reasons. On second was "Poor Planning and Scheduling" and so on.

4.1. Qualitative and Quantitative Analysis Results

Table 2 shows Independent relative importance index (IRII) ranking of top 15 delay reasons

Rank	Problems/Causes	IRII
1	Underestimates Effects Of Inflation & Escalation	0.2773
2	Poor Planning & Scheduling	0.2757
3	Clients Slow Decision	0.1969
4	Design Changes	0.1641
5	Poor Financial Management	0.1624
6	Fluctuation In Material, Labor & Plant Cost	0.1624
7	Project Duration	0.1050
8	Unavailability Of Competent Staff	0.1050
9	Delay In Work Approval	0.1050
10	Poor Quality	0.0804
11	Poor Inventory Management	0.0804
12	Late Monthly Payment From Clients	0.0804
13	Inaccuracy Of Material Take Off	0.0804
14	Unexpected Geological Conditions	0.0804
15	Lack Of Communication	0.0689

Table 2: Independent Relative Important Index

The following table determines the overall ranking of the results of each cause. "Underestimating Effects of Inflation and Escalation" is main reason which has the highest percentage accordingly to IRII, moving on "Poor Planning and Scheduling" is the second main reason that challenges Triple constraints in the Construction Projects and so on leading to Fifty three (53) problems. These Problems are caused by the Contractors which are inexperienced enough, the Technical staff is inexperienced. The Contractors should definitely keep effects of Inflation and Escalation in their mind and should properly plan and schedule their projects so that the projects completes on the Original Contract Duration and Cost.

5 CONCLUSIONS
From this research it have been concluded that Construction projects faced Delays in Cost, Time and Scope due to many different reasons. The reasons are caused by the Clients, Consultants and Contractors. Around, more than 4000 construction activities were inspected all through the world, and result shows that these were not finished inside the predetermined time limit [32]. Related writing presents various reasons of postponements relying on the conditions like heightening of materials costs, Poor Planning and

Scheduling, Design changes, work deficiency or strikes and so forth. Considering these components a rundown of significant reasons for development delay was introduced. The list of main problems that were identified through research papers and from the ongoing projects in Karachi, Pakistan that affects the building projects and triple constraints which causes the project to delay with respect to cost, time and scope. According to the research the main five (5) reasons that cause delay in the Building (Construction) Projects are "Underestimating effects of Inflation and Escalation", "Poor Planning and Scheduling", "Clients-Slow Decisions", "Design Changes" and "Poor Financial Management". Due to these reasons the projects get affected.

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