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Time Contingency Assessment in Construction Project due to various factors

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ABSTRACT: Time schedule is a decisive task in construction project management. For instance, it can materially help to identify the expected financial requirements. It is also an essential tool to the time control process. Construction project time schedule is greatly affected by many uncertain but predictable factors. Hence, a certain percentage of time contingency should be added to the scheduled time to arrive at more a reliable time schedule. This project list discusses of the main factors affecting time contingency and their influence on schedule performance. The main factors are analyzed by using Statistical Package for the Social Scientists. From the analysis Project location, Project size, Design complexity, Equipment availability, material availability, amount of interference, number of Change orders, payment, Time to make a decision, weather condition, soil condition, labor strike, and human resource found to the most critical factors. In addition, an Analytic Hierarchy Process model was developed in order to help the project planner to predict a more reliable time for activity.

KEYWORDS: Project size, Design complexity, Equipment availability, Survey Analysis, Analytic Hierarchy Process

I. INTRODUCTION

The construction process is a complex undertaking. It involves many different activities and participants from initial planning through execution. The requisite tasks, and the roles and responsibilities of the owner, architect engineers, construction managers, contractors and subcontractors can be organized in a number of different ways to deliver a construction project. Despite these many options, building a major construction project today without experiencing schedule delays and cost overruns is often the exception. While there are many factors that can contribute to these poor results, there are two key success factors: effectively managing time and change.

This project aims to identify the various factors influencing duration in construction based on type of projects. Normally the main goals of any successful construction project management system are to complete the project on time, within the planned budget, and with the required quality limits. Due to the unique nature of construction projects, time contingency and project uncertainty are essential for accurate scheduling, which should be flexible enough to accommodate changes without negatively affecting the overall duration of the project. These delays will consequently have a negative impact on the quality and budget of the project. Therefore, estimating time contingency is seen as a major factor for achieving success in construction projects.

Although several industrial sectors developed and used software for estimating time and cost contingencies in order to minimize delays in the construction sector. There are much software used for the analysis, statistics, modeling and development. SPSS Inc., an IBM Company is a leading global provider of predictive analytics software and solutions. The Analytic Hierarchy Process (AHP) is a multi-criteria decision-making. The AHP has attracted the interest of many researchers mainly due to the nice mathematical properties of the method and the fact that the required

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input data are rather easy to obtain. The AHP is a decision support tool which can be used to solve complex decision problems. It uses a multi-level hierarchical structure of objectives, criteria, sub criteria, and alternatives, and then it provides a mechanism for improving consistency.

II. FACTORS INFLUENCING TIME CONTINGENCY ASSESSMENT IN INDIAN CONSTRUCTION PROJECTS

In construction projects, there are many factors affecting the duration of the project. Due to various aspects like Project Location, Project Size, Equipment Availability, Amount of interference, Change orders, Payment delays, Time to take decision, Productivity of labor, Weather condition, Soil condition, Labor strike, Shortage of human resource, Unavailability of labors.

This part of questionnaire consists of 8 main aspect related to time contingency, the main aspects include 80 factors that influencing time contingency, these groups are project condition, management condition, environmental condition, country condition, economical condition, factors related to contractor, factors related to sub contractor, factors related to planners.

Factors Influencing Activity Duration

TABLE 1. Hows the List of Factors Identified from Literature Review

S. No.	Main Aspect	Factors
1	Project condition	Project location
		Project design complexity
		Equipment shortage
		Material shortage
2	Management condition	Scope changes
		Contractor risks
		Change orders
		Inadequacy of detailed drawings
		Imposed holidays
		In accurate planning by any party
		Inaccurate control and follow up
		Workload on the contractor resource
		Client delay commencement date
		Client suspend work
		Late project changes
		Long time to make decision
		High percentage of critical activities in baseline
		Amount of interference
		Inadequate supply, quality, timing of information and drawing designer
Unfavourable interference work in sequence		
Unexpected inadequacy of pre construction site investigation data		
Poor dispute resolution mechanism		
3	Environmental conditions	Bad weather condition
		Labor strike

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		Unknown geological condition
		Labor restriction
4	Economical conditions	Economical stability
		Material market rates
		Design changes due to market demand
		Demand
5	Country conditions	Administration
		Law and regulations
		Unavailability
		Changes in regulation and law
		Political instability
		Influence of power groups
6	Factors related to subcontractors	Shortage of experienced staff
		Contractor start delay
		Contractor poor performance
		Efficiency of planning by contractor
		Bad relationship between top management and site staff
		Bad relationship between site management and labors
		Bad relationship between contractors representatives and client representatives
		Inadequate control over subcontractors
		Bad coordination between labors
		Poor productivity of equipments
		Theft
		Unforeseen events
		Inadequate tender pricing
		More than estimated waste of material in site
		Poor productivity of labors
		Dispute site between labors
		Poor performance of claim
Lack of coordination between engineer and contractors		
Contractor financial difficulties		
7	Factors related to sub contractors	Uncertainties related to sub contractors technical qualification
		Uncertainties related to subcontractors financial stability
		Extra duration due to variability of subcontractors bid
8	Factors related to planners	Clerical errors
		Planners lack of experience
		Wrong method of estimating

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Data Collection

The questionnaires prepared are distributed to the contractors, designers and owners of the different places and different project for the better analysis of the time contingency of the project.

In order to be able to select the approximate methods of analysis, the level of measurement must be understood. For each type of measurement, there is an appropriate method that can be applied and not others. In this project, ordinal scales were used. Ordinal scale is a ranking or a rating data that normally uses integers in ascending or descending order. The numbers assigned to the agreement or degree of influence (1, 2, 3, 4) do not indicate that the interval between scales are equal, nor do they indicate absolute quantities. They are merely numerical labels. Based on Likert a scale project has the following.

Table 2. Data Measurement

Items	Very High	High	Low	Very low
Scale	4	3	2	1

III. SURVEY ANALYSIS

This chapter focuses on describing the respondent’s characteristics in addition to the discussion of the factors that influences time contingency.

Type of Respondents

The number of distributed questionnaires is 100 out of which 60 responded. Out of those 60, 25 were contractors, 21 were consultants, and 14 were owners. The details of respondents participated in the questionnaire is shown in Fig a. The response rate for contractors was 41.66%, for the consultant 35% and for the owner 23.33%.

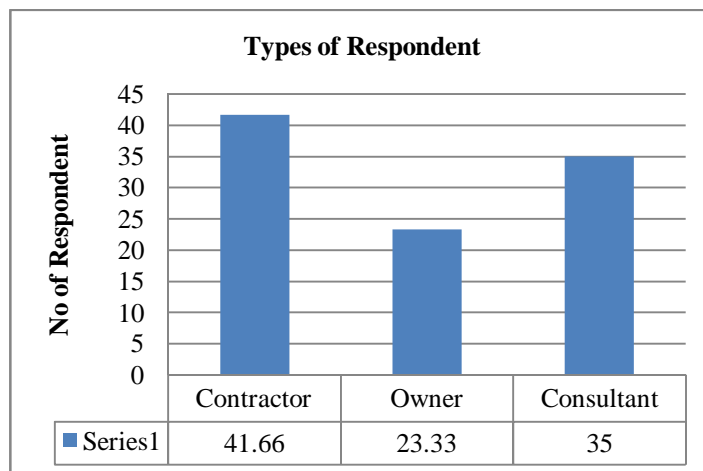


Fig a. Type of Respondent

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The Most Important Factors

The questionnaire respondents were asked to provide numerical scoring expressing their opinions based on their experience in the construction field. The respondents have inserted two scores in front of each factor. First the degree of impact of each factor on projects time contingency. Second, is the probability of occurrence of each factor. The Time Contingency Effect was concluded by multiplying the impact of each factor times its probability of occurrence. The weighted average of each factor was calculated and then divided by the upper scale of the measurement resulting in what is referred to as an importance index. Therefore, the level of importance of each time contingency factor was calculated using Statics Package of Social Scientists (SPSS 16). By analyzing the questionnaires received from the contractors, consultants and owner, the important factors are identified and the rankings are provided.

Based on mean value the most important factors are found from SPSS.16. The Table.3 below Shows the most important factors and means values.

Table 3. The Most Important Factors

Factors	Respondent	Mean
Project location	60	3.417
Project size	60	3.313
Equipment availability	60	3.116
Amount of inference	60	3.116
Change orders	60	3.100
Payment delays	60	2.950
Time to take decision	60	2.930
Productivity of labor	60	2.730
Weather condition	60	2.730
Soil condition	60	2.730
Labor strike	60	2.560
Shortage of human resource	60	2.560
Un availability of labors	60	2.500

IV. MODEL DEVELOPMENT

Analytic hierarchy process (AHP) has been widely used and applied in different fields of theory and practice. It has been applied in multi-criteria decision making, planning and resource allocation, conflict resolution, and prediction problems. Therefore, the AHP is used in the presented research to assess the weights of various factors that affect time contingency through pair-wise comparison matrices.

Time Contingency Calculation

The following are the steps that were used to develop time contingency model using the collected data.

- Determine the relative weight of each major category; i.e. project conditions, management conditions and environmental conditions.
- Determine the weights (W_i) of the sub factors relative to the weight of its category.
- Calculate the factors score (S_i) for each of the thirteen factors (using a 1 - 4 scale) in which one represents the most ineffective and nine represents the most effective to the contingency value.
- Calculate the Probability of occurrence average (P_i) for each of the thirteen factors.
- Multiply the three values $W_i * S_i * P_i$.

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- Sum all the values of multiplication, which constitute the time contingency value CD.

Time Contingency Calculation

Table.4 shows the major condition and it related to the sub factors based on Weight, Relative weight, Probability, Score. Time contingency value arrived from calculation method shown above.

Table 4. Time Contingency Calculation

Criteria	Factors	Weights	Relative Weights (Wi)	(Si)	Probability (Pi)	Time contingency (CD)
Project condition	Size	0.234	0.076	0.638	0.533	0.0258
	Location	0.219	0.071	0.613	0.542	0.0237
	Equipment Availability	0.274	0.089	0.750	0.550	0.0367
	Materials availability	0.270	0.087	0.750	0.583	0.0383
Management condition	Amount of interference	0.184	0.067	0.775	0.567	0.0297
	Number of change orders	0.160	0.058	0.656	0.675	0.0260
	Time required for decisions	0.164	0.060	0.600	0.600	0.0217
	Payments (delays)	0.177	0.065	0.750	0.458	0.0224
	Equipments condition	0.142	0.052	0.520	0.400	0.0109
	Productivity uncertainty	0.171	0.063	0.700	0.617	0.0272
Environmental condition	Soil condition	0.220	0.068	0.613	0.592	0.0247
	Weather conditions	0.264	0.081	0.738	0.533	0.0321
	Strike	0.264	0.081	0.738	0.267	0.0161
	Site shortage of resources	0.250	0.077	0.700	0.600	0.0325
Contingency						0.368

Case Study Description

From AHP analysis result, Table.4 shows case studies taken for the comparison of AHP results. It based on total height, average height floor, no of floors, no of blocks, contractor start date, contractor end date, Delay in months, reason for delays etc.

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Data collected from case studies Table.5 shows the start date, scheduled end date, actual end date, project planned duration, delays in months and contingency percentage.

Table 5. Delay and Contingency Analysis for Several Construction Projects

Project	Start date	Scheduled end date	Actual end date	Planned project duration	Delays in months	Contingency
1	Aug-06	Feb-07	Mar-07	6	1	1/6= 16 %
2	Sep-04	May-05	July-05	8	2	2/8= 20 %
3	Aug-05	April-07	Sep-07	20	5	5/20= 25 %
4	Feb-05	Feb-07	Aug-07	24	6	6/24= 25 %
5	July-03	Oct-04	Mar-05	15	5	5/15= 33 %
6	Feb-02	Feb-04	Feb-05	24	12	12/24= 50 %
7	Sep-01	Mar-03	May-04	32	14	14/32= 77.8%

V. CONCLUSION

Construction projects often suffer from high level of uncertainty in many fronts: time, cost, quality, safety, etc. In order to meet the deadline of a project, an accurate scheduling should be sought. Due to the nature of construction projects, scheduling should be flexible enough to accommodate changes without negatively affecting the overall duration of the project.

This paper describes to identify factors influencing construction activity duration and to list out the factors related to the major aspect of construction projects and framed the questionnaire form. Then the survey is conducted and analyzed by using SPSS.16 to find most critical factors based on mean value. Finally a model developed in Analytic Hierarchy Process.

Similar project using the same methodology can be used to examine the factors affecting time contingency in construction projects. In this project work the time contingency calculation done by using Analytic Hierarchy Process for planned Duration.

Future work is expected on the time contingency calculation using Analytic Hierarchy Process (AHP) for fixed duration projects.

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