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Analysis and Modelling of Factors Causing Delay in Road Construction Projects

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***Abstract* - In construction, delay could be defined as the time overrun either beyond completion date specified in a contract or beyond the date that the parts agreed upon for delivery of a project. 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 parts, resources availability, environmental conditions, involvement of other parts, and contractual relations. However, it rarely happens that a project is completed within the specified time. Analysis and ranking of the factors are done by using statistical package for the social sciences (SPSS) Software.**
Keywords:

I. INTRODUCTION

The main purpose of this study is to identify the significant causes of delay in construction phase of building projects handled by the Department of Engineering Services (DOES). The preliminary investigation of this research revealed that 80% of the building projects handled by the DOES are not completed within the agreed contract period. Delay can be defined as postponing the project completion time due to predicted and unpredicted causes. Completion time is very essential in construction; because "Time is Money". In some cases, to the contractor, delay causes higher overhead costs because of longer construction period. As well as that, material costs may increase due to inflation. To the client, especially if he is investor, delay means losing profits that are planned to be earned after starting the investment on the scheduled time, i.e. lost opportunity.

II. OBJECTIVE OF THE STUDY

The overall objective of this study was to evaluate the factors affecting performance of road construction projects.

1. Evaluate the effect of delay in road construction.
2. Analyze most affecting factor of delay in road construction.
3. Prepare regression model to predict the delay in new projects.

III. METHODOLOGY

The aim of the study is to identify, evaluate by ranking, factors that influence the duration of a road construction. Based on the results of all the reviewed studies, a list of factors was developed, which might affect the delays. A questionnaire was developed in order to evaluate the frequency of occurrence and importance of the identified causes. A total of eighty one (81) factors were identified through detailed literature review and grouped under four (4) broad categories of causes of schedule delays in construction projects in Uganda by the researcher

i. Consultant related factors
ii. Contractor related
iii. Client related
iv. External factors.

IV. FACTORS AFFECTING DELAY IN CONSTRUCTION

There are a large number of factors that affects the delay in constructions. Some of the major factors affecting the delay related to contractor, owner, consultant, services and utilities, Government regulations, and external environment.

TABLE I FACTORS AFFECTING DELAY IN CONSTRUCTION

Group of Causes	S. No.	Causes of Delay
Causes related to contractor	1	Difficulties in project financing by contractor
	2	Rework due to errors during construction
	3	Poor site management and supervision by contractor
	4	Poor communication between contractor and other project parties
	5	Improper planning and scheduling of project by contractor
	6	Inexperienced contractor's manpower
	7	Ineffective construction method implemented by contractor

Causes related to contractor	8	Shortage of manpower
	9	Shortage of materials
	10	Payment problems between contractor and his employees
	11	Shortage of equipment
Causes related to owner	1	Budget availability for the project
	2	Delay in decision making by the owner
	3	Interference by the owner during construction operation
	4	Delay in progress payments by the owner
	5	Lateness in reviewing and approving contract documents by the owner
	6	Delay in approving shop drawings and sample materials
	7	Change of project scope
	8	Suspension of work by owner
Causes related to consultant	1	Delay in performing testing and inspection by consultant
	2	Delay in approving major changes in the scope of work by consultant
	3	Poor communication between consultant and other project parties
	4	Delay in reviewing and approving design documents by consultant
	5	Insufficient experience by consultant
	6	Discrepancies between specifications and drawings prepared by consultant
	7	Bad project cost estimation
	8	Missing dimensions in the drawings
	9	Lack of competent person to monitor the progress at site
	10	Delay in issuing the drawings
	11	Delay in solving design problems
	12	Major change of design during construction by consultant
Causes related to services and utilities	1	Unclear or undefined positions of services networks in drawings
	2	Diversion of obstructing services
	3	Long response from utilities agencies
Causes related to Government regulations	1	Difficulties in obtaining work permits
	2	Tendering system requirement of selecting the lowest bidder
	3	Summer restriction on time of work
	4	Winter restriction on time of work
	5	Lands acquisition
Causes related to external environment	1	Hot weather effect on construction activities
	2	Traffic diversion
	3	Effect of social and cultural conditions of inhabitants
	4	Accidents at construction site
	5	Political situation and security
	6	Scarcity of materials in the market

V. DATA ANALYSIS AND DISCUSSIONS

All the questionnaire survey was done from project manager of the project or project engineer at the site. In some cases, consultant gave the answers on behalf of their clients, both from the owner and the contractor side.

TABLE II IDENTIFIED FACTORS THAT CAUSE DELAY

Factors	S. No.	Identified Factors That Cause Delay	Importance				
			1	2	3	4	5
Acts of God	1	Fire	8	8	4	0	0
	2	Hurricane	5	10	3	2	0
	3	Flood	15	3	2	0	0
	4	Wind damage	6	9	5	0	0
Design related	1	Changes in drawings	0	3	6	9	1
	2	Specifications	0	4	5	8	2
	3	Decision during development stage	0	5	10	4	0
	4	Design development	1	4	9	4	1
	5	Change order	0	3	5	9	2
	6	Shop drawings approval	0	5	10	3	2
	7	Incomplete documents	0	4	8	4	3s
Financial/ Payment	1	Financial process	4	8	5	2	0
	2	Financial difficulties	5	8	4	3	0
	3	Delayed payments	1	7	8	1	2
	4	Economic problems	4	9	6	1	0
Management/ Administrative	1	Labor dispute and strike	10	6	3	1	0
	2	Inadequate planning	4	8	5	2	0
	3	Inadequate scheduling	4	8	6	1	0
	4	Contract modifications	2	7	5	2	1
	5	Under estimation of productivity	3	9	6	2	0
	6	Staffing problems	4	10	4	1	1
	7	Lack of coordination on site	5	9	3	2	1
	8	Transportation delays	3	10	4	2	1
	9	Suspensions	9	7	3	1	0
	10	Lack of high technology	7	6	4	1	2
	11	Poor managerial skills	6	8	3	2	1
Construction related	1	Inspections	0	5	8	2	3
	2	Material procurement	1	6	5	3	3
	3	Lack of qualified craftsmen	1	5	5	2	3
	4	Poor sub-contractors performance	3	4	6	2	1
	5	Defective work	4	4	4	3	2
	6	Different site conditions	4	3	5	2	1
	7	Labor injuries	5	5	5	3	0
	8	Damage to structure	7	3	5	4	0
	9	Construction mistakes	6	7	4	2	0
	10	Poor supervision	6	8	4	0	2
	11	Equipment availability	7	3	5	2	1
Code related	1	Approval process	1	2	5	4	7
	2	Changes in laws and regulations	1	5	6	3	2
	3	Safety rules	3	7	6	0	3

VI. MAJOR DELAY AFFECTING THE CONSTRUCTION PROJECT

After discussion with the clients, project managers, contractors and other personals the main delays affecting the proper functioning of construction projects in Kerala and other parts of south India were taken down and they are as follows.

TABLE III MAJOR DELAY AFFECTING THE CONSTRUCTION PROJECT

1	Delay in handling over the project site.
2	Unforeseen ground conditions for the implementation of the project at project site.
3	Issues occurring in macro and micro level planning of contractor during bidding stage.
4	Improper and poor means of contracting and subcontracting work under the project.
5	Inaccurate specifications of site conditions and project scope.
6	Unrealistic time schedule given in contract and accepted by contractor.
7	Faulty Geo investigation report
8	Slow decisions on project issues from the owner or poor follow up by the contractor.
9	Unrealistic inspection and testing methods proposed in contract.
10	Delay in approval of completed work by client(ie. stage passing)
11	Delay in approval of shop drawings and material samples
12	Non availability of drawings, design on time.
13	Consultant reluctance for change i.e. specifications, drawings, detailing
14	Delay in obtaining permissions and approvals from local authorities.
15	Poor organizational structure of client or consultant.
16	Financial constraints of contractor
17	Delay in payment of running account bills by client to the contractor
18	Inadequate experience of contractor i.e technical incompetence for specific job.
19	Poor labor productivity.
20	Lack of control over sub-contractor
21	Frequent change of sub-contractor.
22	Poor site management and supervision.
23	Use of improper or obsolete construction methods.
24	Increase in scope of work beyond provisions of contract.
25	Rework due to errors in execution of project activities.
26	Rework due to change of design or deviation order.
27	Delay in finalization of rates for extra items.
28	Delay in issue of deviation order.
29	Poor coordination among contractors at site (poor coordination management)
30	Delay in material delivery by vendors.
31	Delay in material to be supplied by the owner.
32	Delay in material procurement.(action by the contractor)
33	Change in material prizes / price escalation.
34	Improper storage of materials leading to damaged material when necessary.
35	Inefficient use of equipment.

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 the schedule; some are delayed over a year. So it is essential to define the actual causes of delay in order to minimize and avoid the delays in any construction project.

There are five objectives of this study which have been achieved.

1. Identify delay factors in construction projects
2. Categorize delay factors in construction projects into nine major categories
3. To analyze the delay factors using SPSS and to demonstrate the ranking of factors and categories according to their mean values on delays
4. Discuss about the case study in construction projects
5. Make recommendations in order to control delays in construction projects

VII. CONCLUSION

This project was therefore, aimed at identifying the major cause of delay in road construction projects through a survey, and quantifies the perceptions of different parties relating to causes, responsible parties, and type delay. Also a detailed work schedule most prepared and monitored in a site and reasons causing delay were identified. Based on the results of questionnaire survey and information gathered the following conclusions were drawn. The top ranked reasons for the delay are given below.

1. Change in order and permit approval.
2. Changes in drawings.
3. Changes in specifications.
4. Incomplete documents.
5. Site inspections.
6. Design Development.
7. Changes in law and order.

VIII. RECOMMENDATION

An overview of the work of this paper can be accessed with the following recommendations based on the top results.

1. The owner financial problems make it important to pay the contractor's dues on time to make it easy the contractors ability to finance the work;
2. Shortage in equipment makes it important to study the availability of the construction equipment needed whether it is for road construction or any other type of construction
3. Inadequate contractor experience (work) causing error makes it necessary to Choose a contractor with a good reputation and sufficient experience in the field of work
4. Shortage in construction materials like Bitumen in the road constructions can cause a big delay especially when the shortage is because of the prices fluctuation. Prices differences should be considered in the contracts
5. Soil investigation is the first step in decision of the design of road with traffic capacity, loads on road, number of layers of pavement. An appropriate Laboratory should be chosen
6. Poor subcontractor performance delays so choosing experienced subcontractors with good reputation is necessary
7. Rework due to change of design or deviation order makes it helpful to settle on the design and have the final approval of achieving the owner's demand and the contractor capability of work.

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