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Investigating delay in construction projects

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Abstract — *Delay is one of the greatest issues that many structures in India are facing. Timely completion of projects is the main component of the project, but the construction method is subject to many variables and unpredictable factors, which are the cause of delay due to many sources such as resource accessibility, external factors, party performance and design and material type Project delay contributes to loss of productivity, enhanced price, termination of contracts and conflicts. The objective of this project is to explore the causes and impacts of delay on construction projects during the construction stage and to provide control measures for delay in the projects. A research is conducted on delays in the building timetable and multiple delay analyses to assess the causes of the delay and its impact in the project. A questionnaire study is then carried out to determine the main causes of delay experienced by clients, contractors, consultants and project managers. Sample population of 250 has been used. From the survey and research, 44 causes of delay were recognized in 8 main organizations such as Owner, Contractor, Consultant, Project, Material, Labor, Government, Equipment and Factors External. Then a model was created and tested to evaluate the construction delay and lastly make suggestions to regulate the construction delay.*

Keywords *construction delay, RII, SEM, Questionnaire survey, Structural equation modelling*

I. INTRODUCTION

The building sector, as far as India is concerned, provides the second biggest after-farm industry because its general contribution to GDP is around 11 percent. The construction industry is a major contributor to both economic and financial uplift. It also offers huge work possibilities. Because of the multidimensional nature of this industry, it has interconnected with other sectors such as refineries, cement, steel, etc. The general growth is feasible in all directions, together with the growth of the building industry. According to the statistics, more than 30 million individuals in India have participated in various building procedures. In specific, the Indian government took needed measures from the Planning Commission such as the CIDC (Construction Development Council) to grow this industry. It is possible to subdivide the entire construction sector into the real estate, infrastructure and industrial sector.

In any stage of a construction project, delays can happen, thus increasing the complete length and total price of a project. The primary goal of project executives is to minimize expenses and time. It is therefore a vital step in stopping its occurrence to identify the causes of delay. Much attention has been given to analyzing delays and managing claims recently. The most significant characteristic of delay assessment is to identify the factors that affect the critical path and thus delay the completion of the project. Before they actually occur, it is important to identify causes of schedule delays. Examples of delay have been found by a number of past research. Others used advanced techniques such as fuzzy logic to measure reasons for delay and adapt activities and durations of the project; or measured the effect of delay of specific delayed events such as who used mathematical models to assess the impact of delay. While these researchers investigated the main causes of delays, they did not investigate the effects when different factors combine to cause delays in the schedule. If it is possible to identify and quantify the influence of different causes alone and in combinations, managers will have more information to help prevent or reduce delays in construction projects.

This study demonstrates the use of a more advanced instrument, namely SEM, to evaluate the complicated interactions. The capacity to manage complicated dependencies is one of the primary benefits of using SEM (Quereshi and Kang, 2014). However, the current study is one of the initial studies using SEM to study the relationships between causes and effects of delays in the construction industry.

II. LITERATURE REVIEW

Construction delay is a global phenomenon faced by many construction industries for this reason, compared to other industries, the magnitude of risk and unpredictability in the construction industries is very high (Gardezi et al 2016). The problem of construction delays, however, is a recurring problem in civil engineering. This often happens throughout the entire life of the project, leading to conflict and legal proceedings (Marzouk and El-Rasas 2016). Successful completion and retention of activities in the approximately calculated cost and time schedule is based on a strategy that involves good professional discernment against the aversion of clients, contractors and consultants. On the other hand, numerous construction work experiences wide delays and thus runs over the final time and estimated value of the project. This issue is more evident in the conventional or antagonistic kind of agreement that rewards the agreement to the least bidder (Odeh and battaineh 2010).

Molenaar, Washington, and Diekman (2015) are one of the initial studies on the application of SEM in project management. They have studied the fundamental factors that affect client-contractor contract disputes. The authors argue that the final set of structural equations provides insight into the variables ' interaction which is not visible with other approaches such as correlation and regression. Zulu (2014) used SEM to study the project management-performance relationship. In particular, Zulu studied the direct and indirect effects on project performance of project leadership, project team, project policy and strategy, project communication, project processes.

Table 1.Delay factors of construction projects

Delay factor	**Reference**
Owner related factor	Adapted from (Amiruddin Ismail1,2, Aboubaker. Y. Y.(2017)
Contractors related factor	Adapted from Alazzaz F and Whyte A(2015)
Consultant related factor	Adapted from Sambasivan T.J. Deepak Ali(2016)
Material related factor	Adapted from Aibinu A A and Odeyinka(2016)
Labour & Equipment related factor	Adapted from Amiruddin Ismail1,2, Aboubaker. Y. Y.(2017)
Project related factor	Adapted from Sambasivan T.J. Deepak Ali(2016)
Government related factor	Adapted from Alazzaz F and Whyte A(2015)
External related factor	Adapted from (Aibinu A A and Odeyinka 2016)
Financial effect	Adapted from Amiruddin Ismail1,2, Aboubaker. Y. Y.(2017)
Stakeholders effect	Adapted from Aibinu A A and Odeyinka (2015)

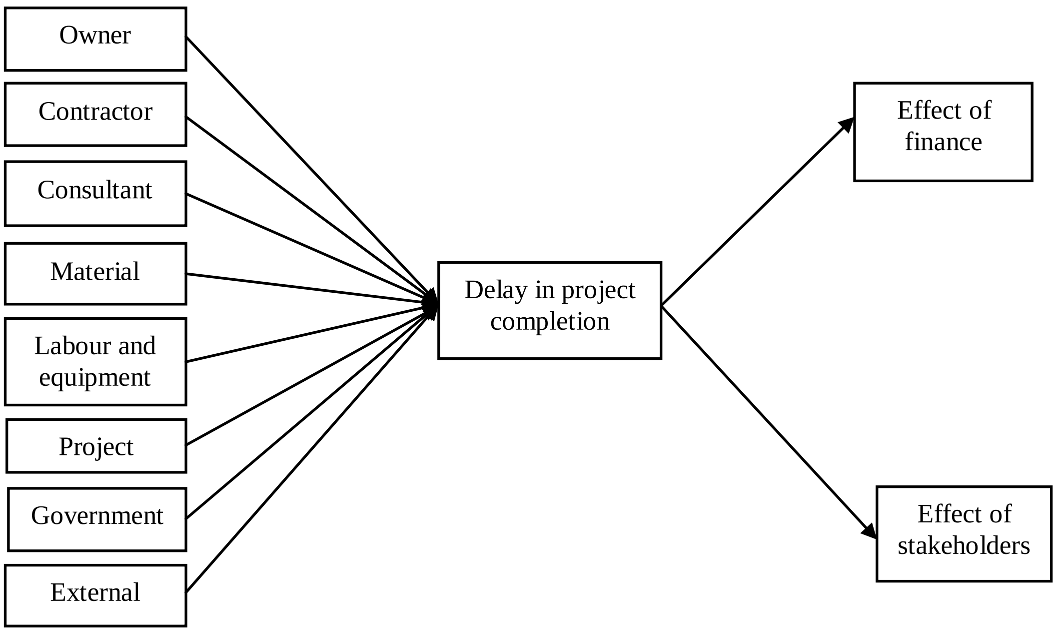

Figure 1. Research model for delay factor and effect

From the literature review provides the theoretical basis to develop the research framework for this study and In order to explore the influences of these factors and effects on construction delays, the research sets out eleven hypotheses as follows

H1: Owner-related [OW] have significant effects on delay in project completion.
H2: Contractor-related factors [OW] have significant effects on delay in project completion.
H3: Consultant-related factors [CN] have significant effects on delay in project completion.
H4: Material have significant effects on delay in project completion.
H5: Government-regulations-related factors [GR] have significant effects on delay in project completion.
H6: Project-related factors [PR] have on significant effects delay in project completion.
H7: External factors [EX] have significant effects on delay in project completion.

H8: Equipment- and Labour-related factors [E&B have significant effects on delay in project completion.
H9: Delay in project completion has significant stakeholders effects [ES].
H10: Delay in project completion has significant financial-related effects [EF].

III. METHODOLOGY

Ten hypotheses supported by literature review are already presented in the previous section. Details of questionnaire development and description of variables are described in the following two subsections.

3.1 Questionnaire Design

To explore the delay factors in the building project, a three-part survey questionnaire was intended for the study. The first portion included fundamental data about participants such as appointment, age and experience. The second part consisted of 36 causes of delays categorizing the research model in 8 delay facto and 7 delay effect categorizing the research model in 2 major groups.A 5-pointLikert scale response was provided by the respondents. The construction and measuring items are presented in Table 2

Based on latent variables, observed factors and power analysis, a prior sample size must be determined (Westland, 2010 ; Hair et al., 2013). A priori sample size calculator for SEM (Soper, 2015) has been used to determine the sample size criterion. The necessary sample size of the calculator is 250 by entering the necessary data, such as 80 percent desired statistical power level, 25 observed variables, 5 constructs, 0.05 probability levels, and 0.3 anticipated medium effect size. This outcome demonstrates that for credible findings, the sample size of 250 is adequate.

Table 2: List of survey items, mean, standard deviation, reliability

Construct	Variable code	Measurement Item	Mean	SD	Cronbach's α
Owner	OW1	Finance and payment of completed works	3.51	0.93	0.786
	OW2	Owner interference	3.43	0.83	
	OW3	Slow decision making	3.36	0.83	
	OW4	Unrealistic contract duration imposed	2.41	0.77	
Contractor	CO1	Sub-contractors	3.42	0.75	0.925
	CO2	Site management	2.74	0.92	
	CO3	Construction method	2.92	0.92	
	CO4	Improper planning	3.51	0.76	
	CO5	Mistakes during construction stage	3.49	0.79	
	CO6	Inadequate contractor experience	3.49	0.79	
	CO7	Negotiation	3.58	0.81	
	CO8	Lack of communication	3.01	0.96	
	CO9	Change order	3.4	0.74	
Consultant	CN1	Contractor management	2.57	0.7	0.799
	CN2	Preparation and approval drawings	3.14	0.96	
	CN3	Quality assurance	2.46	0.69	
	CN4	Waiting for approval of tests and inspection	2.96	0.99	
Material	MA1	Availability of material	3.55	0.74	0.776
	MA2	Availability of quality materials	2.74	0.93	
	MA3	Shortage in material	3.65	0.67	
	MA4	On time delivery	2.94	0.98	
Labour and equipment	LA1	Low labour productivity	3.52	0.72	0.786
	LA2	Lack of appropriate skills	3.6	0.73	
	LA3	Equipment availability	2.93	0.86	
	LA4	Inadequate equipment	3	0.89	
Project	PR1	Original contract duration is too short	2.54	0.69	0.797
	PR2	Some designers are not suitable for implementation	3.08	0.86	
	PR3	Non-provision of bonus for early completion	2.46	0.66	
	PR4	Lack of financial liquidity	3.14	0.93	
Government	GO1	Administrative and financial procedure	2.6	0.7	0.803
	GO2	Changing government regulation	2.64	0.71	
	GO3	Permit from different government office	3.26	0.92	
External	EX1	Weather condition	3.48	0.86	0.840
	EX2	Regulatory changes	3.58	0.8	
	EX3	Problem with neighbors	3.56	0.85	

	EX4	Unforeseen site condition	3.56	0.94	
Financial	Time	Time overrun	3.78	0.75	0.774
	Cost	Cost overrun	3.82	0.73	
	Quality	Poor quality	3.02	1.08	
Stakeholders	ST1	Litigation	2.94	0.73	0.811
	ST2	Arbitration	3.25	0.83	
	ST3	Breach of contract	2.84	0.96	
	ST4	Disputes	2.86	0.93	

The information gathered will be processed to remove missing values, flat liners, duplicate reactions and abnormal values that impede meaningful interpretation. The first part will examine the reliability of the constructs and a confirmatory factor analysis will be carried out using SPSS 24 after the descriptive assessment of the information. Principle component analysis technique will be used for factor extraction then the validity of the material will be verified, validity will be discriminated against and the instrument's convergent validity will be checked. Using SPSS AMOS software, a structural equation model (SEM) will be created. This will assess how well the conceptual model proposed explains or suits the information to be gathered.

IV. RESULTS

SEM is an efficient statistical method for the analysis of the association between measurement and structural models (Vinodh and Joy, 2012) between various factors (Hair et al., 1998). Calculated with the highest probability estimate in SPSS using AMOS A powerful a priori foundation of prior study warrants the use of confirmatory factor assessment (CFA) rather than exploratory factor analysis (Shah and Ward, 2007). The CFA involves the information needed to fulfill SEM's assumptions of normality (Bortolotti et al. 2015). An iterative CFA-based adaptation procedure permitted the simultaneous modification of the measures to assess the unidimensionality of the first and second order constructs. Figure 2 illustrates the CFA model created for this research.

4.1 Descriptive statistics

Pre-testing with a panel of experts and modification of their suggestions, sequence, and wording of the questionnaire and layout ensured the content validity of the draft questionnaire. A pilot study of 30 participants from the randomly chosen participants of the target population was conducted (Perneger et al., 2015) Provides the survey items used in the research. The survey method has been adopted for data collection as it facilitates the collection of information within a brief period of time from target participants. Interviews with the respondents were conducted face-to-face. In this survey, the respondents were contractors, engineers, and others, consultants, or business owners.

For the profiles linked to the overall data about the participants and projects, a descriptive statistics was performed. This data involves respondents ' organisation, years of experience and appointment involving by respondents. The highest number of questionnaires received was from the engineers (120), 25 and 70, 35 of questionnaires were received from the contractors, and the consultants, others respectively. The number of respondents having experience from less than 3, 3-5, 5-10 and greater than 10 years is 60, 85,75,30 respectively .They account for a large rate of the respondents. Thus, the collected data are relatively reliable and valuable. About the types of project, the majority of the projects is school, hotel, flat etc.

4.2 Measurement model, validity, and reliability

The first-order measurement models of the constructs are derived, and overall fit is evaluated. The derived models were recursive and over-identified. Internal consistency reliability of all constructs can be assessed using Cronbach's α. The value of Cronbach's α exceeding 0.7 is typically considered as adequate (Cronbach, 1951; Nunnally, 1978) and acceptable if at least 0.6 (Chen and Paulraj, 2004). From the Table 2, the values of Cronbach's α are between 0.6 and 0.9 which are in the acceptable range, which demonstrates satisfactory internal consistency reliability of all dimensions. Statistically, significant loading of all items from the respective latent constructs is the condition for the convergent validity (Anderson and Gerbing, 1988). All items significantly loaded on their underlying construct (Table 3), show convergent validity.

The fit indices such as χ^2, ratio of χ^2 to degrees of freedom (χ^2/df), the model square residual (SRMR), normed fit index (NFI), incremental fit index (IFI), Tucker-Lewis Index (TLI), and comparative fit index (CFI) were used for the evaluation of the measurement model(χ^2= 260.797), χ^2/df=1.285,GFI=.855; NFI=.848; IFI =.972, TLI =.969; CFI=.972, RMSEA =.028;RMR=.035). No strict guidelines are followed to represent an acceptable fit (Schermelleh-Engel et al., 2003). However, several parameters are evidenced from various references and academic works. According to Byrne (2001), an RMSEA value of less than 0.08 is reasonable and a value of 0.05 or less indicates a good fit. According to Schermelleh-Engel et al. (2003) and Kline (2005), an SRMR between 0.05 and 0.10 is considered favourable. The values of GFI, NFI, TLI, CFI, and IFI close to 1.0 or greater than0.9 represent a good fit (Byrne, 2001; Kline, 2005). Small sample sizes, GFI and NFI, are often underestimated and hence the measurement models can be good fit indices with the exclusion of these two indices (Byrne, 2001; Kline, 2005). According to Shah and Goldstein (2006) CFI, TLI, and IFI are considered fit measures for small sample sizes. So the overall fit of the model was acceptable and thus supporting the uni dimensionality and convergent validity of all dimensions.

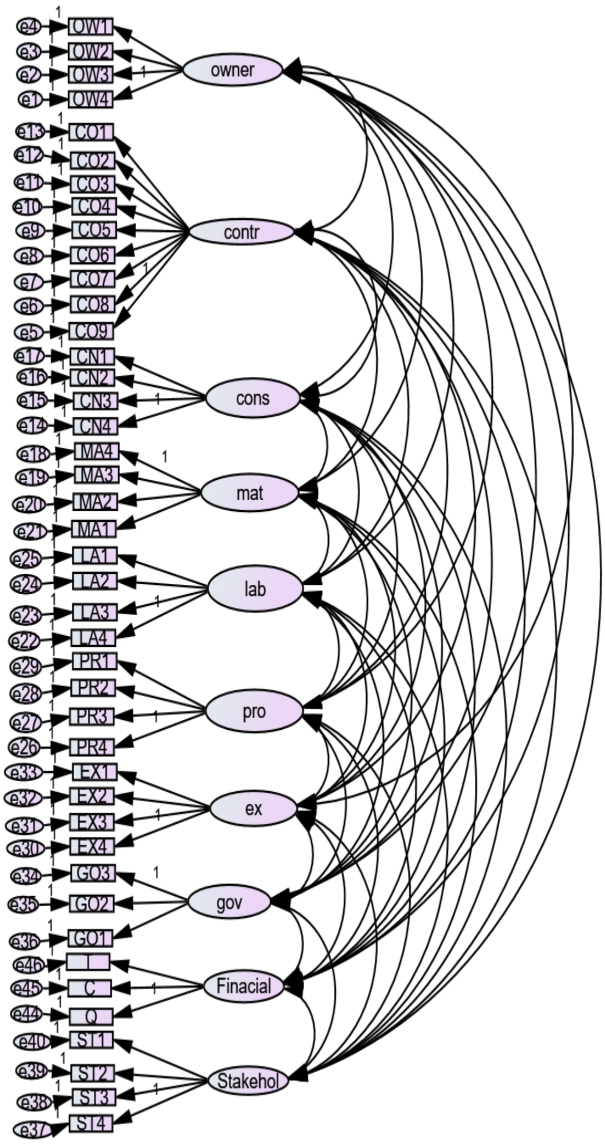

Figure 2: Measurement model for delay factors and effects

Discriminant validity indicates the degree to which each construct is distinct from one another (Hair et al., 1998). Discriminant validity occurs if the square root of the average variance extracted (AVE) by each construct goes above the corresponding inter-variable correlation (Fornell and Larcker, 1981). Table 4 provides first-order inter-construct correlations, reliability, and discriminant validity of all constructs. The square roots of AVEs are indicated on the diagonal in Table 4, and all these values are greater than the construct correlations and thus satisfying the condition for reasonable discriminant validity. The composite reliabilities of all constructs are above the acceptable standard of 0.70, which shows good construct reliability (Fornell and Larcker, 1981).

Table 3: Results from confirmatory factor analysis

Construct	Variable code	Final factor loading
Owner	OW1	0.873
	OW2	0.822
	OW3	0.786
	OW4	0.463

Contractor	CO1	0.951
	CO2	0.662
	CO3	0.666
	CO4	0.824
	CO5	0.798
	CO6	0.906
	CO7	0.728
	CO8	0.673
	CO9	0.907
Consultant	CN1	0.906
	CN2	0.641
	CN3	0.815
	CN4	0.798
Material	MA1	0.865
	MA2	0.638
	MA3	0.810
	MA4	0.699
Labour and equipment	LA1	0.850
	LA2	0.711
	LA3	0.570
	LA4	0.697
Project	PR1	0.896
	PR2	0.676
	PR3	0.845
	PR4	0.586
Government	GO1	0.867
	GO2	0.879
	GO3	0.712
External	EX1	0.804
	EX2	0.781
	EX3	0.794
	EX4	0.860
Financial	Time	0.895
	Cost	0.859
	Quality	0.681
Stakeholders	ST1	0.903
	ST2	0.808
	ST3	0.761
	ST4	0.748

Table 4: First order inter construct correlation, reliability, discriminant validity

	CR	AVE	Owner	Contractor	Material	Labor	Project	External	Government	Consultant	Stakeholders	Financial
Owner	0.802	0.516	0.718									
Contractor	0.934	0.619	0.237	0.787								
Material	0.814	0.548	0.026	0.070	0.740							
Labor	0.804	0.522	0.018	0.281	0.141	0.722						
project	0.829	0.562	0.016	0.118	0.183	0.074	0.750					
External	0.842	0.571	0.112	-0.041	0.013	-0.018	0.087	0.756				

Government	0.826	0.619	0.005	-0.051	0.114	-0.032	0.075	0.063	0.787			
Consultant	0.838	0.573	-0.033	0.176	0.236	0.010	0.080	0.063	0.012	0.757		
stakeholders	0.817	0.536	0.106	0.069	0.092	0.149	-0.024	-0.006	0.134	0.142	0.732	
Financial	0.824	0.623	0.015	0.032	-0.037	-0.075	0.046	0.048	0.021	0.036	0.117	0.789

4.3 Evaluation of structural model

The structural model developed by path diagram is shown in Figure 4.2. The model goodness of fit values are as follows $\chi^2 = 10650480$, $\chi^2/df = .846$, GFI = 0.846; NFI = 0.847; IFI = 0.965, TLI = 0.962; CFI = 0.962, RMSEA = 0.030; RMR = 0.036. Based on the guidelines stated earlier it can be inferred that there is adequate model fitness. Summary of the hypotheses tested is presented below.

H1, Owner-related [CO] factor have significant effects on delay in project completion is accepeted. The estimated coefficient of $\beta = .154$ ($p<0.001$) for the relationship between Owner-related [CO] factor and delay in project completion is significance indicating a strong support for the hypothesis *H1*.

H2, Contractor-related factors [OW] have significant effects on delay in project completion is accepted. The estimated coefficient of $\beta = .241$ ($p<0.001$) for the relationship between Contractor-related factors [OW] and delay in project completion is significance indicating a strong support for the hypothesis *H2*.

H3, Consultant-related factors [CN] have significant effects on delay in project completion accepted. The estimated coefficient of $\beta = .152$ ($p<0.001$) for the relationship between Consultant-related factors [CN] and delay in project completion significance indicating a strong support for the hypothesis *H3*.

H4, Material related factor have significant effects on delay in project completion is accepted. The estimated coefficient of $\beta = .202$ ($p<0.001$) for the relationship Material related factor and delay in project completion is significance indicating a strong support for the hypothesis *H4*.

H5 Equipment- and Labour-related factors [E&B have significant effects on delay in project completion is accepted. The estimated coefficient of $\beta = .045$ ($p<0.001$) for the relationship between Equipment- and Labour-related factors [E&B] and delay in project completion significance indicating a strong support for the hypothesis *H5*.

H6 , Project-related factors [PR] have on significant effects delay in project completion accepted. The estimated coefficient of $\beta = .228$ ($p<0.001$) for the relationship between Project-related factors [PR] and delay in project completion significance indicating a strong support for the hypothesis *H6*.

H7 Government-regulations-related factors [GR] have significant effects on delay in project completion accepted. The estimated coefficient of $\beta = .177$($p<0.001$) for the relationship between Government-regulations-related factors [GR] and delay in project completion significance indicating a strong support for the hypothesis *H7*

.*H8*, External factors [EX] have significant effects on delay in project completion accepted. The estimated coefficient of β = ..253($p<0.001$) for the relationship between External factors [EX] and delay in project completion significance indicating a strong support for the hypothesis *H8*.

H9, Delay in project completion has significant stakeholders effects [ES]. accepted. The estimated coefficient of $\beta = .193$ ($p<0.001$) stakeholders effects and delay in project completion significance indicating a strong support for the hypothesis *H9*.

H10 Delay in project completion has significant financial-related effects [EF] accepted. The estimated coefficient of β = .135 ($p<0.001$) for the relationship between financial related effect and delay in project completion significance indicating a strong support for the hypothesis *H10*

Table 5: Results of Examining Hypotheses in the Developed Structural Model

H	Dependent variable	Path	Independent variable	Value of path coefficients	P Value	Significant or not
H1	Delay	⇦	Owner related factor	0.384	.000	Yes
H2	Delay	⇦	Contractor related factor	0.247	.000	Yes
H3	Delay	⇦	Consultant related factor	0.215	.000	Yes
H4	Delay	⇦	Material related factor	0.257	.000	Yes
H5	Delay	⇦	Labour and equipment related factor	0.152	.000	Yes
H6	Delay	⇦	Project related factor	0.174	.000	Yes
H7	Delay	⇦	Government related factor	0.343	.000	Yes

H8	Delay	⇦	External related factor	0.394	.000	Yes
H9	Financial	⇨	Delay	0.384	.000	Yes
H10	Stakeholders	⇨	Delay	0.316	.000	Yes

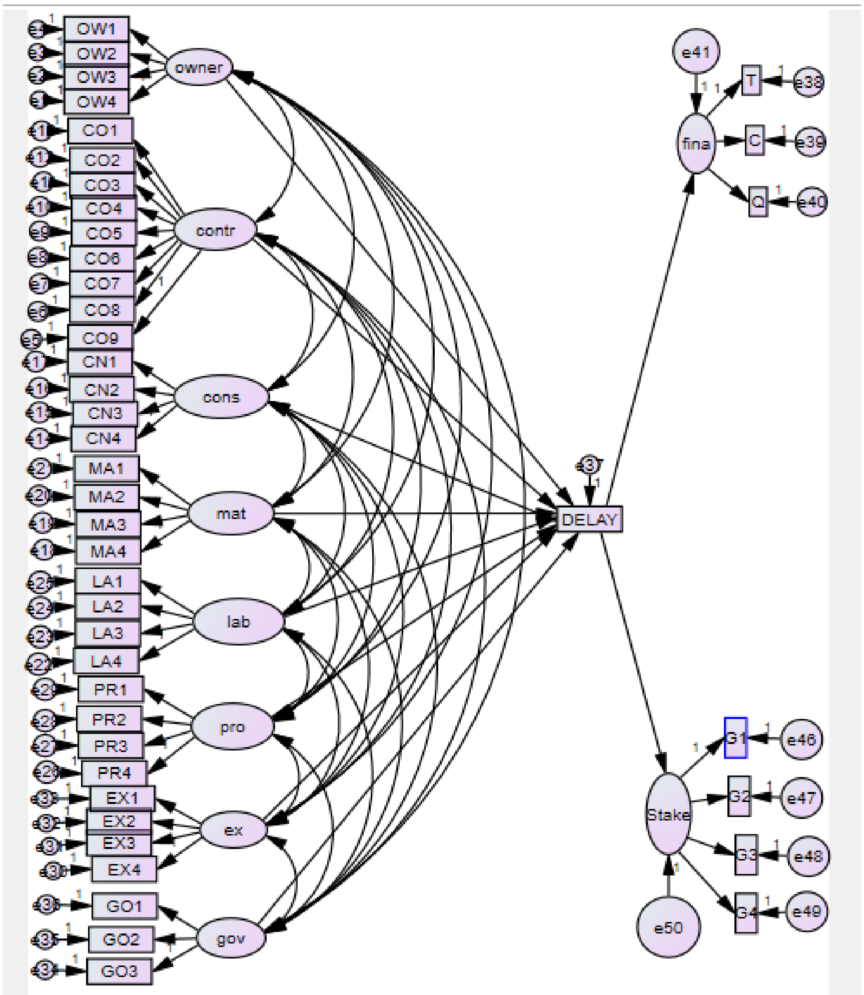

Figure 3: Structural model for delay factors and effects

V. DISCUSSION AND SUGGESTIONS

The study has investigated the delay construction projects in several projects in Calicut and the study tries to find the factors that determine the delay factors and effects. Based on extensive literature review four hypotheses were developed. Also, a research model was formulated based on the four hypotheses which were tested and analyzed
The [β-value] path coefficients indicate the path's impact on the dependent variable. As per [Lohmöller J-B. Structural modeling vs. predictive: PLS vs. ML. Latent Variable Path Modeling with Partial Least Squares: Springer] if β-value above 0.1 is acceptable. As shown in Figure 4.4, the result of the path coefficients shows that all β-value is above 0.1. This means that the developed model is acceptable.

Hypotheses H1 to H10 were tested by evaluating the significance of the path coefficients as well as β in the structural equation model specifically developed for this study. Also, there was scrutiny of the paths among the variables. In the hypothesized model proposed in this research study. As shown in Table 4.4, eleven paths were statistically significant [p-values < 0.05]. Thus, the model's path coefficient values indicate that the external factor with the highest coefficient value [0.394] has the greatest impact on the construction delay on my assumed project, whereas the greatest impact of the effects was Financial [EF] effects [0.384] due to the construction delay. Then second largest impact delay effect is owner related factor[ow] co efficient value is(.384)then other factor ranking as followers government related factor[GOV][.343],material related factor [.257], contractor related factor[CO][.247],consultant related factor[CN][.215],project related factor [PR][.174], Labour & Equipment related factor[LA][.152]. In delay effect stakeholders path coefficient value is .316.

5.2 Suggestions

The results from the questionnaire are analysed in SEM model to obtain the most important causes of delays. Making suggestions for this results.

- **Owner related Delays**
  - The owner must be self-sufficient with his funds and other financial matters before starting of project.
  - The owner must also have a clear perspective and quick decisions regarding final design so that no change in design is requested once after the start of work.
  - The owner must be cautious at the time of selection of contractor/ consultant and make sure they do not have any previous record of illegitimate delays resulting in a loss to the owner.

- **Contractor related delays**
  - Improve the knowledge and skills of technical staff
  - Manage the financial resources and plan cash flow by utilizing progress payment
  - Planning and scheduling the works from start of project and during the work to match with the resources and time to develop the work to avoid delays
  - Improve site management and supervision to achieve completion of work within specified time
  - Implement delay penalties to contractors

- **Consultant related delays**
  - Improve coordination between parties
  - There must be no lagging in the collection of information from the owner so that design would be done appropriately as expected by owner and also the owner will not suggest any further changes.
  - They must also be sure while hiring subcontractors in design also because in large design works main architects hire subcontractors for MEP works.

- **Material related delays**
  - Coming to material supply, if there is no time limit in starting a project then start the work at a time when the market is free from inflation and when there are low material costs because at the end it makes a huge difference if the costs of raw materials vary.
  - Accumulate materials as per the requirement by carefully estimating the quantities of materials required for the project.
  - Employ proper material handling and storing techniques so that materials would be long lasting.
  - Hire a good material supplier keeping in mind his previous record of delivering materials on time.
  - Always maintain good relations with material suppliers, if he works well it is good or else hire

- **Labour &Equipment related delays**
  - Be sure at the time of signing the contract regarding Labour issues and their work schedule whether it must be 5day- 10hour shifts or 6day-8hours shifts depending on the owner’s requirement.
  - Hire a Labour supplier who got skilled workers and productive in nature, because Labour plays a key role in influencing project productivity and overall completion of work.
  - Keep maintenance of equipment

- **Project related**
  - Check design suitable for implementation

- **Government related delays**
  - Administrative And Financial Procedure Perform work following the rules and regulations prescribed by the city board where the work is going on.
  - Speed up Permit From Different Government Office

- **Overall**

  - An extensive planning that include contingencies for unforeseen circumstance
  - Managing ineffective planning and scheduling with help of project management tools & techniques (WBS, CPM, PERT, EVM etc.)
  - Establish a clear communication between parties
  - Training can be provided for the project team members to improve their skills & capacity

VI. CONCLUSIONS

The present study investigated delay factor and effect of construction projects. The study shows the positive significant effect of 'delay factors', 'delay effects ', which influences the overall delay of construction projects .The final model will be very helpful for the companies who want to know more about the delay of construction projects. Model will tell the cause of delay factors and its effects on delay in project completion. In this study our theoretical model is valid and it supported by the data very well. The most critical delay factor id external related factor and delay effect iv cost overrun. The model is overall fit with the data it was evaluated using common model goodness-of-fit measures estimated by IBM SPSS AMOS 21. Overall, our model exhibited a reasonable fit with the data collected. We also tested the hypotheses based on our model.

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