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Critical Mitigation Strategies of Road Construction Delays in Nigeria

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ABSTRACT: *Confirmatory Factor Analysis (CFA) was used to identify the critical delay mitigation strategies from among nineteen significant road construction delay mitigation measures. The outcome of the Exploratory Factor Analysis was deployed as input data in Covariance-Based Structural Equation Modelling (CB-SEM) using the Analysis of Moment Structures (AMOS) software version 20.00 incorporated with programme Statistical Package for Social Science (SPSS). The critical construction delay mitigation strategies of road projects awarded in the Niger Delta Region of Nigeria are: use of competent consultant to supervise and monitor project, enforcing liquidated damage clauses, adequate contingency allowance, up-to-date technology utilization (best practice) in project management, proper project planning and scheduling, and frequent progress site meeting. Also, the CB-SEM revealed the existence of strong relationships among the latent variables. These include relationships between: preventive measures and predictive measures: predictive measures and corrective measures, and preventive measures and corrective measures.*

Keywords : Mitigation strategies, Covariance-Based Structural Equation Modelling, Niger Delta Development Commission, Observed and Latent variables, Measurement models, Path diagrams, Explorative Factor Analysis, Confirmatory Factor Analysis, Model Re-Specification.

I. INTRODUCTION

Structural Equation Modelling (SEM) is widely used in psychology, sociology as well as marketing and management sciences [1]. And it is finding increasing applications in research issues of construction engineering and management [2]. Ogbeide *et al* used structural equation modelling to determine the critical causes of road construction delay in the Niger Delta Region of Nigeria [3]. Also, Ogbeide and Ehiorobo used Explorative Factor Analysis to identify nineteen significant construction delay mitigation strategies for road projects awarded in the Niger Delta Region of Nigeria [4]. In these studies, the Cronbach Alpha Collection (CAC) was employed to test the questionnaires used for data collection and they were found to be statistically significant. The reliability analysis employed the use of interclass correlation of coefficients, multivariate analysis of variants (MANOVA) and the box test (Covariance Matrix).

There is the misnomer among researchers in the use of the words “significant” and “critical” interchangeably to refer to the same set of factorial indicators. The need to efficiently and effectively deploy resources on road construction mitigation strategies would as a matter of priority consider the critical delay mitigation measures from among the significant factors. In this study, Covariance-Based Structural Equation

Modelling (CB-SEM) is used to determine the critical delay mitigation strategies out of the established nineteen significant factors in an earlier study [4]. Also, the model fit in CB-SEM will be used to conduct the maximum likelihood prediction methodology which is dependent on the multivariate normality that reproduces the correct measure of associations among the latent variables [5].

II. LITERATURE REVIEW

Structural Equation Modelling is the graphical equivalent of a mathematical representation to study relationship between dependent variables to explanatory/indicative variables. Also, SEM uses various types of theoretical models to describe the relationship among observed and latent variables, which provides the quantitative test for a researcher's hypothesis [6]. It is a systematic statistical technique used in investigating causal relationships between multidimensional factors and it enables the development of a causal indicator model in which a latent theoretical construct of interest is represented by measured variables [7]. Apart from allowing analysis to determine what factors underlie a set of indicators, SEM also make it possible to examine the strength of the relationship between these theoretical constructs. The basis for the measurement model is the reliability and the constructs validity tests. The construct validity consists of two parts, namely: convergent validity and discriminate validity. The convergent validity refers to the extent to which the items of the specified constructs should converge to share a high proportion of variance in common while, discriminate validity means the extent to which one construct is truly different from another construct [8]. According to Ng et al, Structural Equation Modelling (SEM) functionality is better than other multivariate techniques including multiple regression, path analysis and factor analysis in analysing the cause-effect relations between latent constructs [9]. Types of multivariate analysis techniques are shown in Table 1. Some previous studies collectively identified four approaches in the use of Structural Equation Modelling ([11]. [12], [13]). They are the Covariance-based structure analysis (CB-SEM), the Component-based analysis using partial least square estimation (PLS-SEM), the Generalised Structural Component Analysis (GSCA) and the Nonlinear Universal Structural Relational Modelling (NEUSREL),

Table 1: Type of Multivariate Analysis (Source: Zainol [10])

Type	Method
First Generation Technique	Factor Analysis
	Cluster Analysis
	Multidimensional Scaling (MDS)
	Logistic Regression
	Multiple Regression
	Multivariate Analysis of Variance (MANOVA)
Second Generation Technique	Structural Equation Model, SEM - Covariance Based - Partial Least Square

CB-SEM uses observed and latent variables. Observed variables have data that can be directly measured by a researcher, for example, numeric responses to a rating scale question on a questionnaire, while latent variables are variables that are of interest to a researcher but not directly observable [8]. In this study, the latent variables are the corrective, preventive, predictive, and organisational strategies of road construction delay. Reasons have been advanced supportive of the use of CB-SEM in studies of this nature to include: inclusion of latent variables in the model with the measurable variables, as well as examining and establishing relationships among the latent variables [14]. Kline states that only factor loading of measured variables greater than 0.60 are reserved for SEM analysis [15].

III. RESEARCH METHODOLOGY

CB-SEM Modelling

The Covariance method (Maximum Likelihood approach) was used since it can accommodate missing data and zero values. The aim was to compute the path coefficients through the reduction of the variances among sample covariance as well as those estimated by the proposed model. SEM Analysis Flowchart is shown in Figure 1.

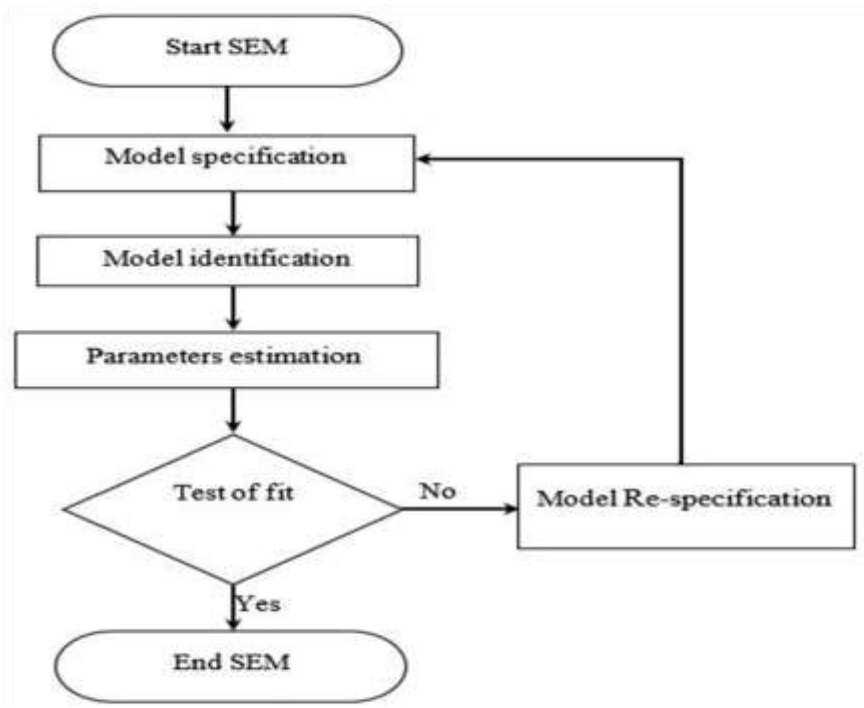


Figure 1: SEM Analysis Flowchart (Source: Alaloul et al [5])

To evaluate the adequacy of the model in explaining the validity of the set hypothesis, Model-fit statistics adopted from the works of previous researchers were employed ([1], [16], [17], [18], [19], [21], [22]). The model fit statistics used to assess the models overall goodness of fit is presented in Table 2.

Table 2: Goodness-of-Fit statistics of model measurement

S/n	Fit Index	Description	Recommended Range	Source
	Absolute Goodness of Fit			
1	CMIN (Minimum discrepancy function)		-	Hair et al (2010)
2	DF (Degree of freedom)		-	Hair et al (2010)
3	CMIN Significance		p < = 0.05	Hair et al

	(Model probability value)			(2010)
4	CMIN/DF	Check whether the covariance structure of the model is adequately the same as the covariance matrix of the observed data	< 5.0	(Bentler and Bonnett, 1980)
5	GFI (Goodness of Fit Index)	Check overall fit of the model; percent of the covariance of the observed data can be explained by the covariance of the model	> 0.80	(Joreskog & Sorbom, 1981
6	AGFI (Adjusted Goodness of Fit Index)		> 0.80	(Joreskog & Sorbom, 1981
Incremental Fit Measure				
7	NFI (Normal Fit Index)	Explore the improvement of the overall fit of the model to independent model.	> 0.90	(Bentler and Bonnet 1980)
8	RFI (Relative Fit Index)		> 0.90	(Bollen, 1986)
9	CFI (Comparative Fit Index)	Examine whether the model fits the observed data better than the independent model	> 0.90	(Hu and Bentler 1999)
10	TLI (Tucker-Lewis Index)		> 0.90	(Tucker and Lewis, 1973)
Absolute Badness of Fit				
11	RMSEA (Root-mean-square error of approximation	Check the mean value of the covariance residual	< 0.06	(Cudeck & Henly, 1991)

In this model, Joreskog and Sorbom introduced two Goodness-of-fit indices (GFI) and AGFI (Adjusted GFI) [16]. The GFI indicates goodness-of-fit, and the AGFI attempts to adjust the GFI for the complexity of the model. There are also the Tucker-Lewis Index TLI better known as the Non-Normed Fit Index (NNFI) [17]. The Normed Fit Index, NFI was derived by Bentler and Bonett [18]. The Normed and Non-Normed Fit indices adjust for complexity of the model. The RFI index is related to the NFI index [19]. According to Hox and Bechger, simulation research shows that all these indices still depend somewhat on sample size [20]. The TLI/NNFI shows the best overall performance. The Comparative-Fit-Index (CFI) examine whether the model fits the observed data better than the independent model [21]. If the model fits perfectly, the fit indices should have a value of 1. Usually, a value of at least 0.90 is required to accept a model, while a value of at least 0.95 is required to judge the model fit as “good” [14]. Another approach to model fit is to accept that models are only approximations, and that perfect fit may be unrealistic to ask for. Thus, the problem is to assess how well a given model approximates the true model. This view led to the development of an index called RMSEA, for Root Mean Square Error of Approximation [22].

Exploratory Factor Analysis and Generation of input data for CFA analysis

Exploratory factor analysis (EFA) was employed to explain the opinions of the client with regards to mitigation strategies of construction delay of roads projects awarded by the Niger Delta Development Commission (NDDC), and found that nineteen mitigation strategies were significant [4]. They are shown in Table 3 while the selected mitigation variables with factor loading greater than 0.60 are shown in Table 4. Using the outcome of exploratory factor analysis, the input data for confirmatory factor analysis were generated from the raw questionnaires and presented in Tables 5.

Table 3: Group Ranking of Delay Mitigation Strategies for NDDC Road Projects (Source: Ogbeide *et al* [4])

Ranking	S/No.	Delay Mitigation Measures	Correlation Index	Group
1	1	Use of competent consultant to supervise and monitor project	1.000	Organisational
2	2	Enforcing liquidated damage clauses	0.980	Corrective
	3	Use up-to-date technology utilization (best practice) in project management	0.980	Predictive
3	4	Adequate contingency allowance	0.940	Corrective
	5	Use appropriate construction methods	0.940	Predictive
4	6	Frequent progress site meeting	0.920	Preventive
	7	Clear information and communication channels	0.920	Preventive
	8	Comprehensive contract documentation	0.920	Preventive
	9	Ensure adequate and available financial resources for projects	0.920	Preventive
	10	Accurate initial project duration estimate	0.920	Predictive
	11	Community buy-in /involvement	0.920	Organisational
	12	Selection of competent contractor	0.920	Organisational
	13	Offering incentives for early completion	0.920	Organisational
	14	Proper project planning and scheduling	0.861	Preventive
5	15	Accurate initial cost estimates	0.861	Predictive
	16	Prompt payment for certified works	0.861	Organisational
6	17	Proper and timely material procurement	0.803	Preventive
	18	Complete and proper design at the right time	0.803	Preventive
7	19	Frequent/proper coordination of project team members	0.745	Preventive

Table 4: Selection of most significant mitigation measures of road construction delays according to Client view

Latent Constructs	Client's view of most important factors
CORRECTIVE	Adequate contingency allowance (COR-1) Enforcing liquidated damage clauses (COR-2)
PREVENTIVE	Frequent progress site meeting (PRV-1) Proper project planning and scheduling (PRV-5)
PREDICTIVE	Use up-to-date technology utilization (best practice) in project management (PRD-1) Use appropriate construction methods (PRD-2)
ORGANISATIONAL	Community buy-in /involvement (ORG-2) Use of competent consultant to supervise and monitor project (ORG-3)

Table 5: Extract of CFA data based on client's view on most significant mitigation measures of road construction delay

PRV-1	PRV-5	PRD-1	PRD-2	COR-1	COR-2	ORG-2	ORG-3
5	5	4	4	4	4	4	5
3	4	4	4	3	5	3	4
4	2	3	3	4	5	2	2
5	4	4	3	3	3	4	5
3	2	3	4	4	3	3	2
3	2	3	4	4	3	3	2
5	5	5	4	4	5	4	4
5	5	5	5	3	2	5	4
3	4	3	4	3	3	3	3
3	3	3	3	3	3	3	3
5	5	5	4	4	5	4	4
3	2	2	3	2	2	3	3
4	5	5	5	4	3	5	5
4	5	4	4	3	3	4	4
4	4	4	4	4	3	5	3
4	5	4	5	4	3	4	4
3	5	3	5	4	5	5	3
4	4	4	5	4	4	3	4
5	5	5	5	5	5	5	5
4	4	4	5	1	3	2	4
5	5	5	4	4	5	4	4
5	5	5	4	4	5	4	4
5	5	4	4	4	4	4	5
3	4	4	4	3	5	3	4
4	2	3	3	4	5	2	2
5	4	4	3	3	3	4	5
3	2	3	4	4	3	3	2
3	2	3	4	4	3	3	2
5	5	5	4	4	5	4	4

Measurement Model

Figure 2 shows the final measurement models for delay mitigation measures of road projects awarded by NDDC. In Figure 2, the path arrows show the hypothetical relationship among the dependent variables and the independent variables (measured indicators). The rectangular shapes indicate the observed variables that are the individual items on the questionnaire survey.

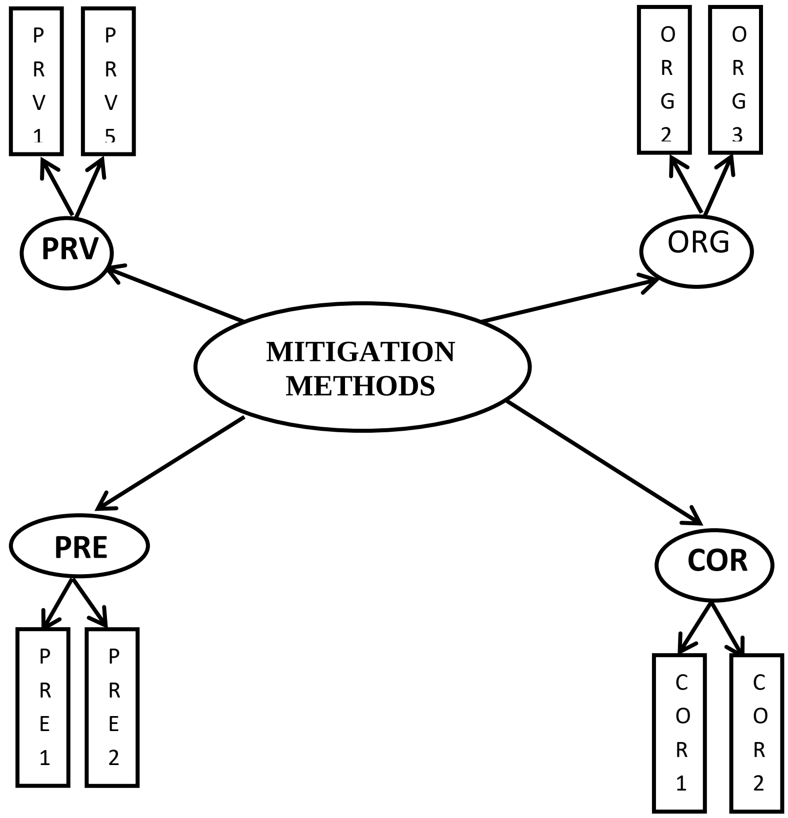


Figure 2: Measurement model for delay mitigation strategies

IV. ANALYSIS OF RESULTS

Path Diagrams for CB-SEM

Confirmatory factor analysis (CFA) is a multivariate statistical procedure that is used to test how well the measured variables represent the number of constructs. The path diagram for the final confirmatory factor analysis of significant mitigation measures for construction delay based on the client view point is presented in Figure 3.

Analysis of Model Results

To determine the unobserved variables with strong relationship, covariance matrix was calculated and presented in Table 6. With a computed p-value >0.05, it was concluded that the relationship between the different mitigation strategies is not very strong. To determine the observed variables with the highest contributory influence (critical factors) on construction delay, the square multiple correlation coefficients was computed for all the selected observed variables (significant factors) and presented in Table.7.

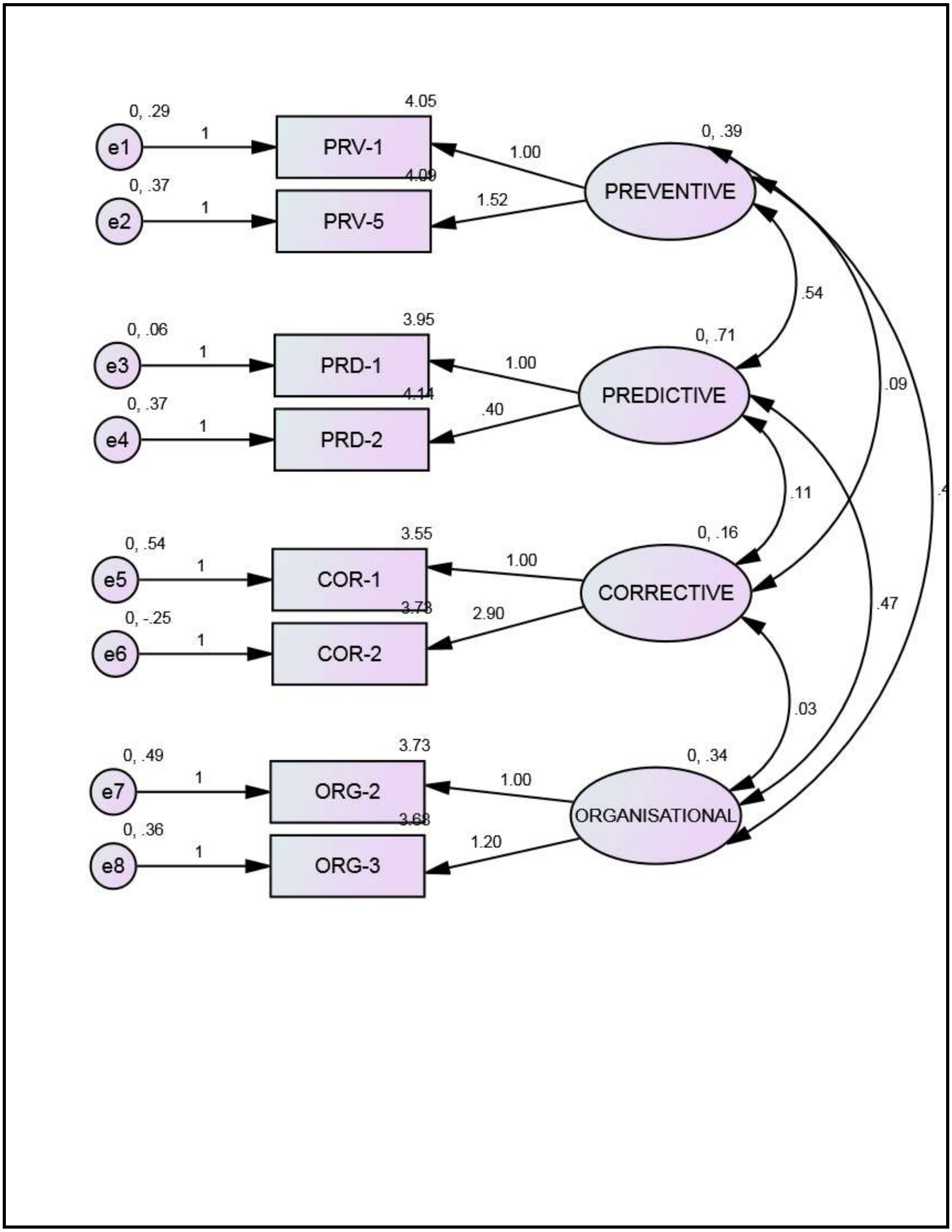


Figure 3: Path diagram for mitigation strategies of construction delay

Table 6: Structural equation results for final model of significant mitigation measures of construction delay from client's view

Covariances: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
PREVENTIVE	<-->	PREDICTIVE	.541	.136	3.967	***	par_5
PREDICTIVE	<-->	CORRECTIVE	.111	.086	1.295	.195	par_6
ORGANISATIONAL	<-->	CORRECTIVE	.027	.043	.638	.524	par_7
ORGANISATIONAL	<-->	PREDICTIVE	.469	.136	3.455	***	par_8
PREVENTIVE	<-->	CORRECTIVE	.087	.068	1.279	.201	par_9
ORGANISATIONAL	<-->	PREVENTIVE	.429	.124	3.449	***	par_10

Table 7: Square multiple correlation estimate of the final model of mitigation strategies for construction delay from client's view

Squared Multiple Correlations: (Group number 1 - Default model)

	Estimate
ORG3	.582
ORG2	.412
COR2	1.224
COR1	.229
PRD2	.229
PRD1	.916
PRV5	.705
PRV1	.568

Variables with squared multiple correlations greater than 0.5 are selected as critical. From the result of Table 7, the critical mitigation strategies of construction delay on road projects awarded by NDDC were identidfied to include:

i. Enforcing liquidated damage clauses (1.224)
ii. Up-to-date technology utilization (best practice) in project management (0.916)
iii. Proper project planning and scheduling (0.705)
iv. Use of competent consultant to supervise and monitor project (0.582)
v. Frequent progress site meeting (0.568)

Assessment of Model Fitness of significant mitigation measures for construction delay from client's view

Results of the model fit statistics is presented in Tables 8 a-c

Table 8a: Result of model fit statistics on mitigation strategies of construction delay-a

Model Fit Summary

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	30	60.069	14	.000	4.291
Saturated model	44	.000	0		
Independence model	16	253.444	28	.000	9.052

Baseline Comparisons

From the results of Table 8a, it was observed that the model is significant with calculated p-value of 0.000. In addition, the chi square (CMIN) value of 60.069 for the default model is small compared to the value of the independent model of 253.444 and this support the proposed theoretical model being tested. More fit-statistics of the model is presented in Tables 8b and 8c respectively.

Table 8b: Result of model fit statistics on mitigation strategies of construction delay-b

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.763	.526	.808	.591	.796
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

Parsimony-Adjusted Measures

Model	PRATIO	PNFI	PCFI
Default model	.500	.381	.398
Saturated model	.000	.000	.000
Independence model	1.000	.000	.000

Table 8c: Result of model fit statistics on mitigation strategies of construction delay-c

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.277	.207	.350	.000
Independence model	.433	.385	.482	.000

AIC

Model	AIC	BCC	BIC	CAIC
Default model	120.069	135.951		
Saturated model	88.000	111.294		
Independence model	285.444	293.915		

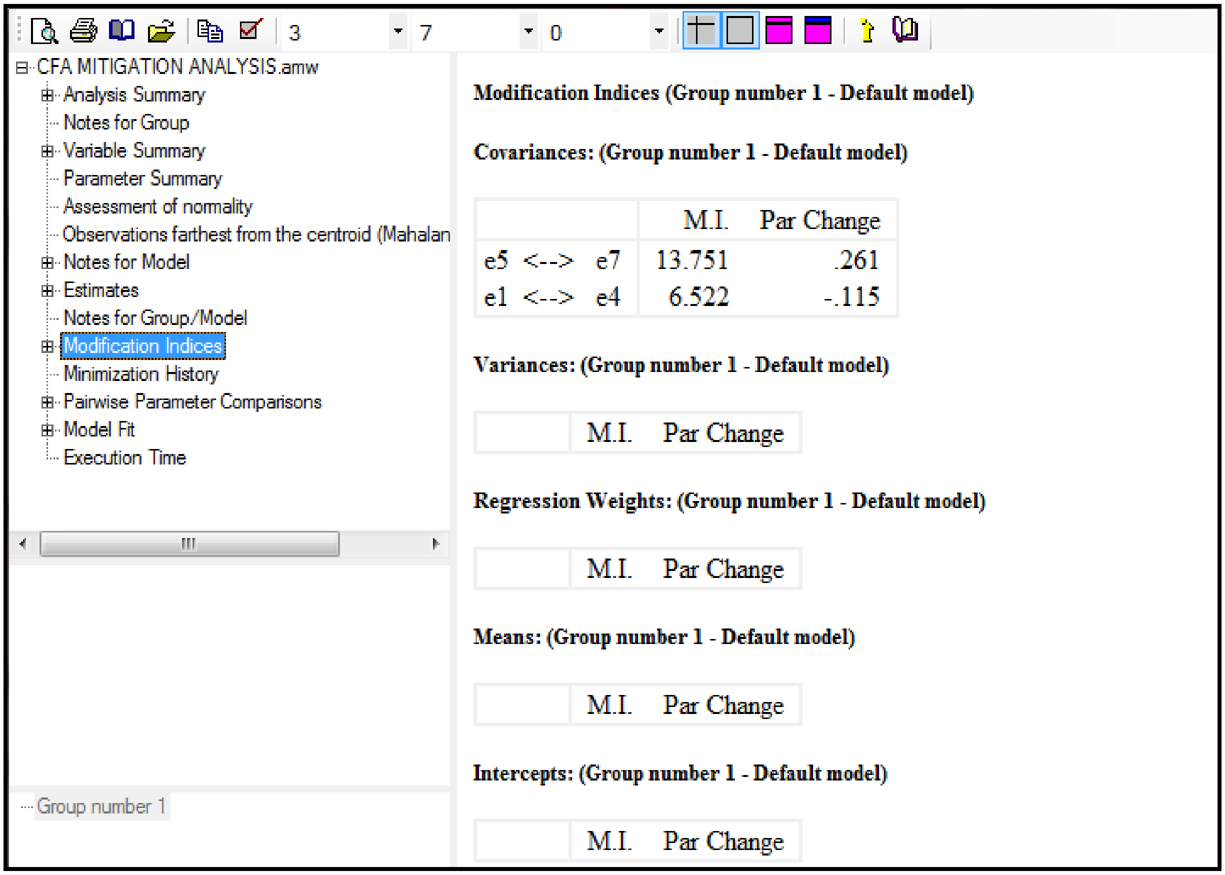
Using the recommended fit statistics of model measurement presented in Table 1, the overall result of the model was generated and presented in Table 9.

Table 9: Fit statistics of model measurement on mitigation strategies

S/n	Fit Index	Recommended Range	Source	Obtained Model Index
1	CMIN (Minimum discrepancy function)	-	Hair et al (2010)	60.069
2	DF (Degree of freedom)	-	Hair et al (2010)	14
3	CMIN Significance (Model probability value)	p < = 0.05	Hair et al (2010)	0.000
4	CMIN/DF	< 5.0	(Bentler and Bonnett, 1980)	4.291
5	GFI (Goodness of Fit Index)	> 0.80	(Joreskog & Sorbom, 1981	0.808
6	AGFI (Adjusted Goodness of Fit Index)	> 0.80	(Joreskog & Sorbom, 1981	
7	NFI (Normal Fit Index)	> 0.90	(Bentler and Bonnet 1980)	0.763
8	RFI (Relative Fit Index)	> 0.90	(Bollen, 1986)	0.526
9	CFI (Comparative Fit Index)	> 0.90	(Hu and Bentler 1999)	0.796
10	TLI (Tucker-Lewis Index)	> 0.90	(Tucker and Lewis, 1973)	0.591
11	RMSEA (Root-mean-square error of approximation	< 0.06	Cudeck, R., and Henly, S. J.,1991); Hox and Bechger, 1998	0.277

From the results of Table 9, it was observed that the statistical parameters of the model are poor except for CMIN/DF. To improve the parameters of the model, the modification indices were generated for model re-specification and presented in Table 10.

Table 10: Modification indices for mitigation strategies of construction delay



Modification Indices (Group number 1 - Default model)

Covariances: (Group number 1 - Default model)

	M.I.	Par Change
e5 <--> e7	13.751	.261
e1 <--> e4	6.522	-.115

Variances: (Group number 1 - Default model)

	M.I.	Par Change

Regression Weights: (Group number 1 - Default model)

	M.I.	Par Change

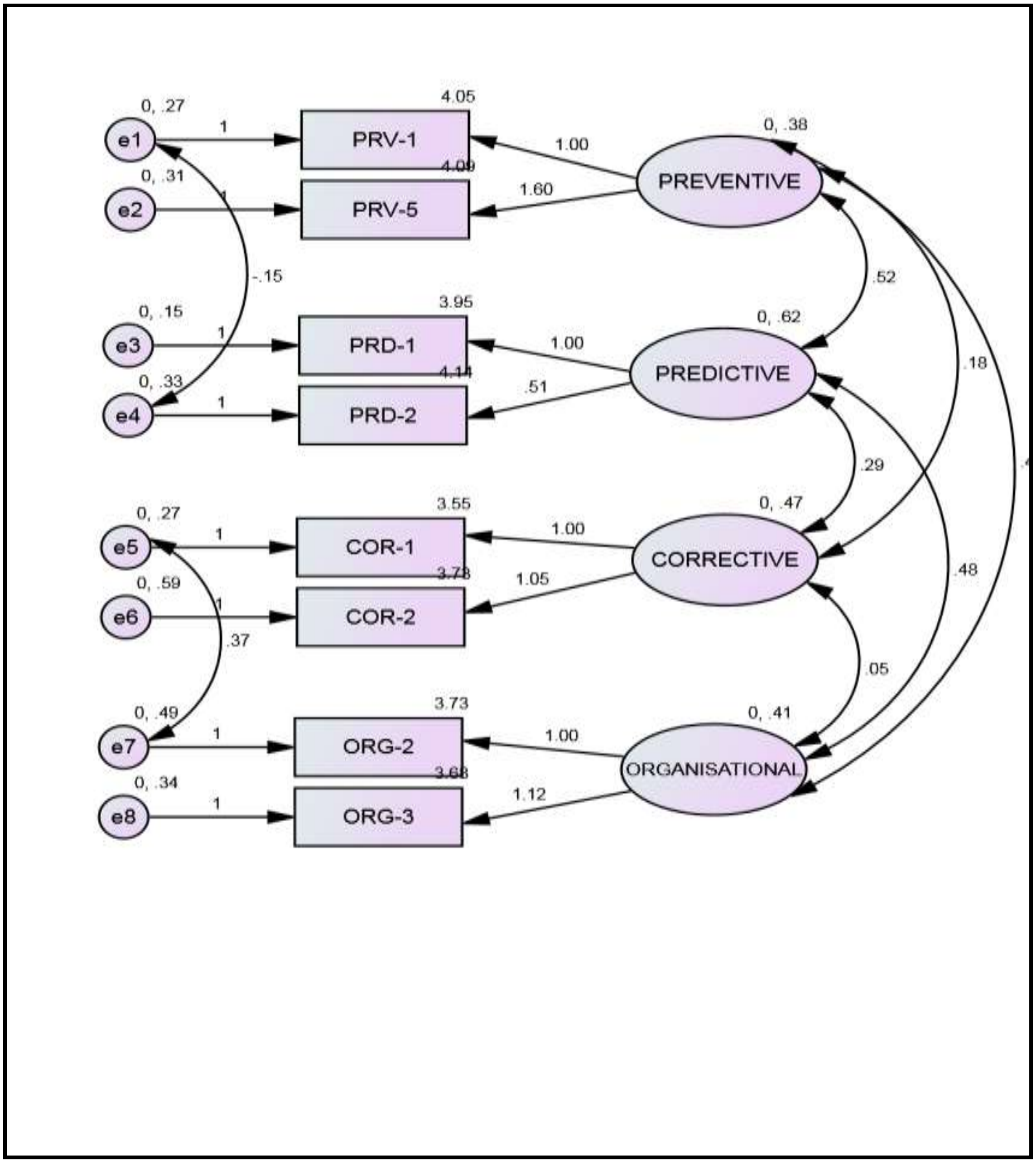
Means: (Group number 1 - Default model)

	M.I.	Par Change

Intercepts: (Group number 1 - Default model)

	M.I.	Par Change

In the first phase of model re-specification, a covariance relation was introduced between the error variables (e5 and e7) and (e1 and e4) as presented in the path diagram of Figure 4.



Fiure 4: Model Re-specification diagram for mitigation strategies of construction delay

Results of Covariance Matrix for Model Re-Specification

Based on model re-specification, the re-calculated covariance matrix is presented in Table 11.

Table 11: Structural equation results for final model after re-specification

Covariances: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
PREVENTIVE	<-->	PREDICTIVE	.519	.132	3.949	***	par_5
PREDICTIVE	<-->	CORRECTIVE	.285	.115	2.469	.014	par_6
ORGANISATIONAL	<-->	CORRECTIVE	.049	.099	.492	.623	par_7
ORGANISATIONAL	<-->	PREDICTIVE	.485	.137	3.549	***	par_8
PREVENTIVE	<-->	CORRECTIVE	.184	.091	2.021	.043	par_9
ORGANISATIONAL	<-->	PREVENTIVE	.441	.122	3.620	***	par_10
e5	<-->	e7	.368	.100	3.683	***	par_11
e1	<-->	e4	-.148	.053	-2.766	.006	par_12

From the result of Table 11, the following inference were drawn;

i. The relationship between preventive measures and predictive measures became very strong after model re-specification with a p-value of 0.006.

ii. The relationship between predictive measures and corrective measures became very strong after model re-specification with a p-value of 0.014

iii. The relationship between preventive measures and corrective measures became very strong after model re-specification with a p-value of 0.043

This relationship is depicted in Figure 5.

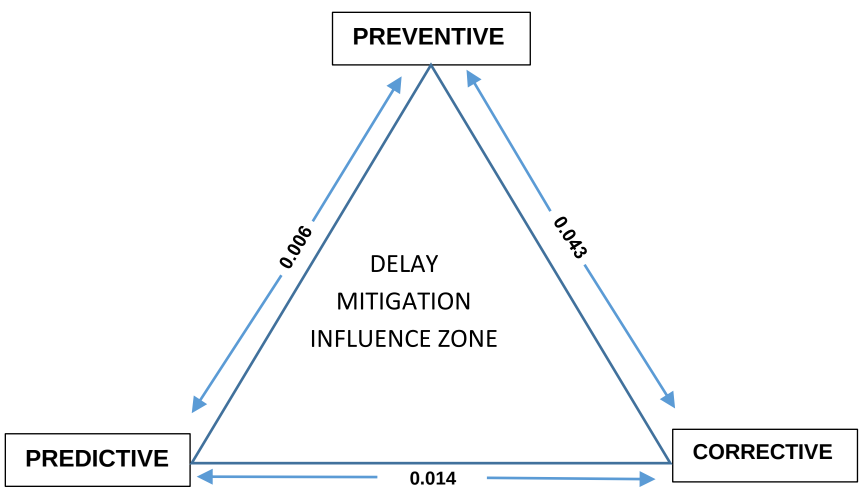


Figure 5: Conceptual Relationships among Latent Variables

Results of Square Multiple Correlation for Model Re-Specification

To determine the observed variables with the highest contributory influence on construction delay mitigation, the square multiple correlation coefficients was re-calculated after model re-specification for all the selected observed variables and presented in Table 12.

Table 12: Square multiple correlation estimate of mitigation measures of the final model after re-specification

Squared Multiple Correlations: (Group number 1 - Default model)

	Estimate
ORG3	.597
ORG2	.454
COR2	.468
COR1	.637
PRD2	.323
PRD1	.806
PRV5	.758
PRV1	.584

From the result of Table 12, the critical mitigation strategies of construction delay were identidfied after model re-specification and presented to include:

i. Up-to-date technology utilization (best practice) in project management (0.806)
ii. Proper project planning and scheduling (0.758)
iii. Adequate contingency allowance (0.637)
iv. Use of competent consultant to supervise and monitor project (0.597)
v. Frequent progress site meeting (0.584)

It is observed that all critical mitigation measures identified in the initial model run in Table 7 are confirmed in the model re-specification except the substitution of “enforcing liquidated damage clauses” with “adequate contingency allowance”. They both belong to the Corrective Latent Construct, and thus shall be jointly accepted as critical construction delay mitigation measures in this study. This is depicted in a Fish-Bone diagram in Figure 6.

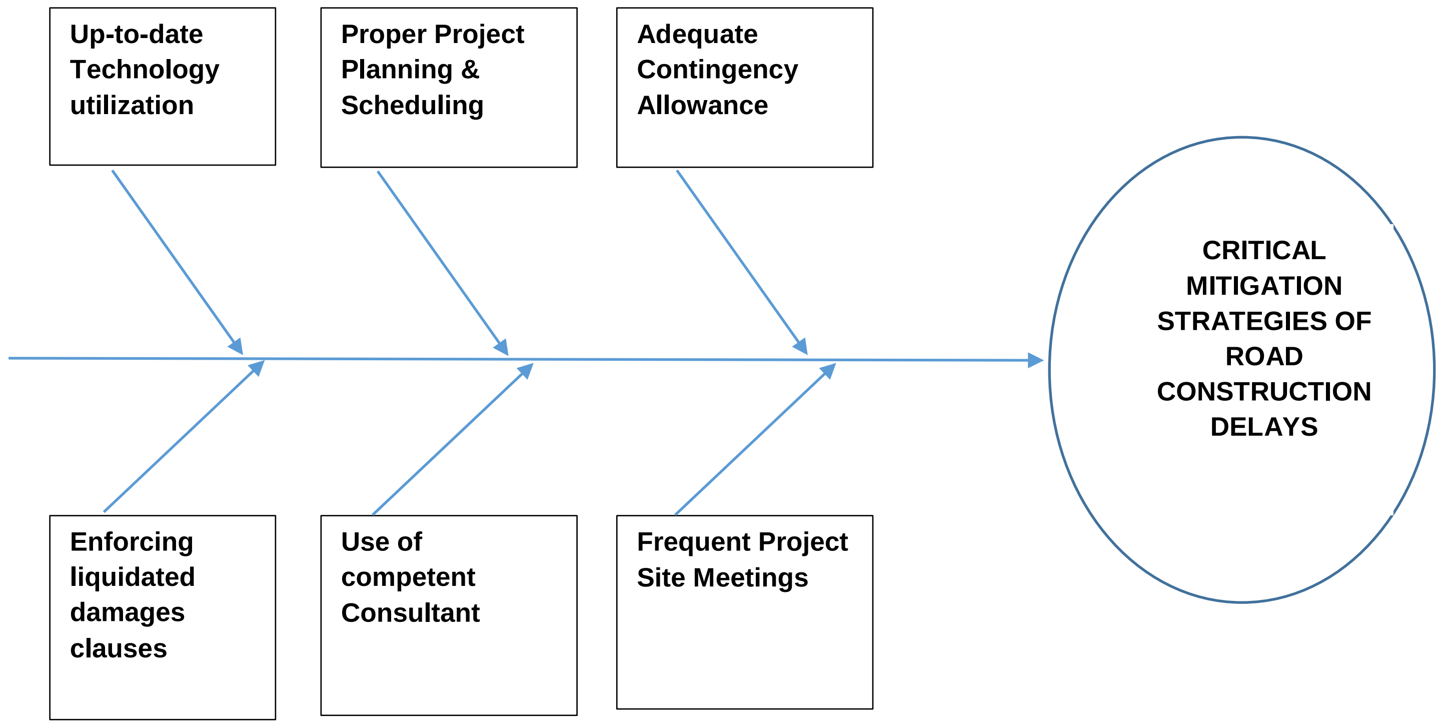
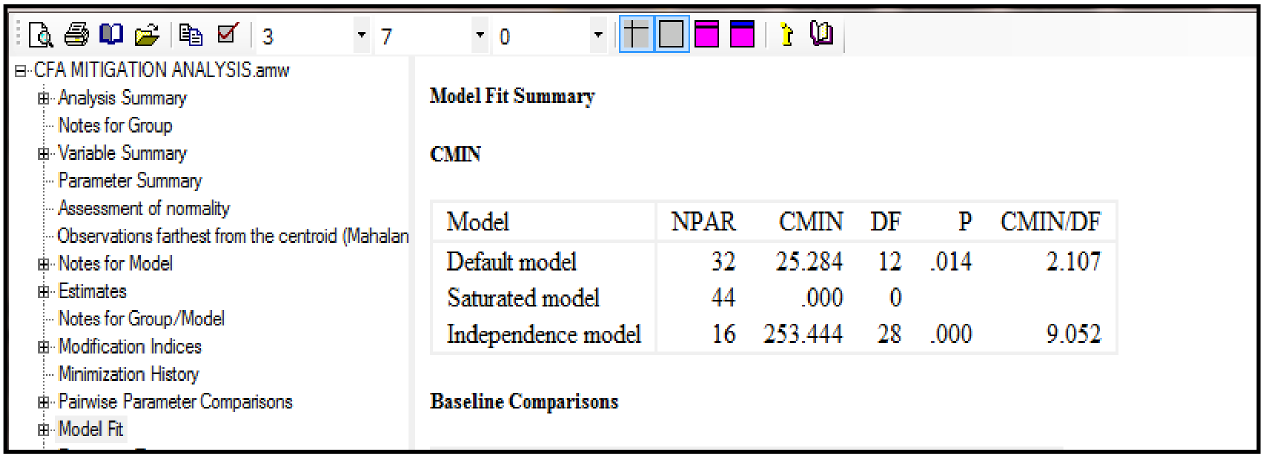


Figure 6: Fish-Bone Diagram of Critical Mitigation Strategies of Road Construction Delays

Result of Model Fitness after Re-Specification

Results of the model fit statistics after model re-specification is presented in Tables 13 a-c respectively.

Table 13a: Result of model fit statistics after model re-specification-a



Model Fit Summary

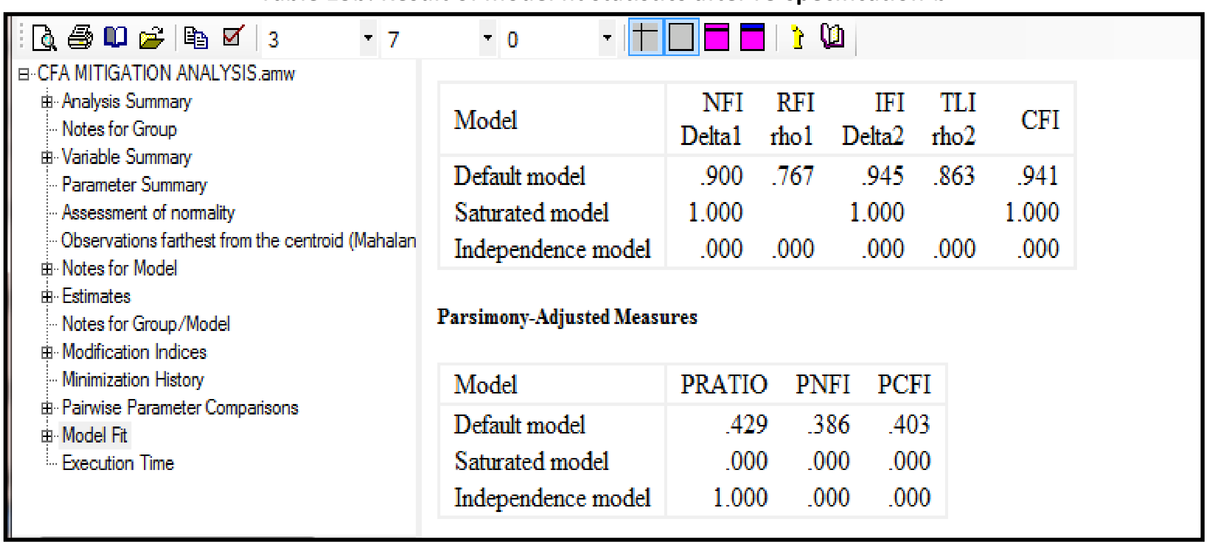
CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	32	25.284	12	.014	2.107
Saturated model	44	.000	0		
Independence model	16	253.444	28	.000	9.052

Baseline Comparisons

From the results of Table 13a, it was observed that the model is significant with calculated p-value of 0.014. In addition, the chi square (CMIN) value of 25.284 for the default model is small compared to the value of the independent model of 253.444 and this support the proposed theoretical model being tested. More fit-statistics of the model after re-specification are presented in Tables 13b and 13c respectively.

Table 13b: Result of model fit statistics after re-specification-b



Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.900	.767	.945	.863	.941
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

Parsimony-Adjusted Measures

Model	PRATIO	PNFI	PCFI
Default model	.429	.386	.403
Saturated model	.000	.000	.000
Independence model	1.000	.000	.000

Table 13c: Result of model fit statistics after re-specification-c

- CFA MITIGATION ANALYSIS.amw
  - Analysis Summary
  - Notes for Group
  - Variable Summary
  - Parameter Summary
  - Assessment of normality
  - Observations farthest from the centroid (Mahalan
  - Notes for Model
  - Estimates
  - Notes for Group/Model
  - Modification Indices
  - Minimization History
  - Pairwise Parameter Comparisons
  - Model Fit
  - Execution Time

FMIN

Model	FMIN	F0	LO 90	HI 90
Default model	.588	.309	.059	.738
Saturated model	.000	.000	.000	.000
Independence model	5.894	5.243	4.145	6.515

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.160	.070	.248	.029
Independence model	.433	.385	.482	.000

Using the recommended fit statistics of model measurement presented in Table 1, the overall result of the model after re-specification was generated and presented in Table 14.

Table 14: Fit statistics of model measurement after re-specification on mitigation strategies of construction delay

S/n	Fit Index	Recommended Range	Source	Obtained Model Index
1	CMIN (Minimum discrepancy function)	-	Hair et al (2010)	25.284
2	DF (Degree of freedom)	-	Hair et al (2010)	12
3	CMIN Significance (Model probability value)	p < = 0.05	Hair et al (2010)	0.014
4	CMIN/DF	< 5.0	(Bentler and Bonnett, 1980)	2.107
5	GFI (Goodness of Fit Index)	> 0.80	(Joreskog & Sorbom, 1981	0.945
6	AGFI (Adjusted Goodness of Fit Index)	> 0.80	(Joreskog & Sorbom, 1981	
7	NFI (Normal Fit Index)	> 0.90	(Bentler and Bonnet 1980)	0.900
8	RFI (Relative Fit Index)	> 0.90	(Bollen, 1986)	0.767
9	CFI (Comparative Fit Index)	> 0.90	(Hu and Bentler 1999)	0.941
10	TLI (Tucker-Lewis Index)	> 0.90	(Tucker and Lewis, 1973)	0.863
11	RMSEA (Root-mean-square error of approximation	< 0.06	Cudeck, R., and Henly, S. J.,1991); Hox and Bechger, 1998	0.160

From the results of Table 14, it was observed that the statistical parameters of the model became good after model re-specification.

V. CONCLUSION

The finding from this study includes:

I. The Covariance-Based Structural Equation modelling showed an acceptable overall model fit after model re-specification and hence, the theorized model fit well with the observed data. This confirms that road construction delay in Nigeria can be controlled, minimised and/or eliminated by corrective-, preventive-, predictive-, and organisational mitigation strategies.

II. The critical mitigation measures for construction delay of road projects awarded by NDDC in the Niger Delta Region from client's perspective include: use of up-to-date technology utilization (best practice) in project management, proper project planning and scheduling, adequate contingency allowance, enforcing liquidated damage clauses, use of competent consultant to supervise and monitor project, and frequent progress site meetings. A Fish-Bone diagram was generated. Thus, in the face of limited financial and human resources challenging most Ministries, Departments and Agencies (MDGs) in Nigeria, the recurring incidence of road construction delay in Nigeria can be effectively controlled, minimised and/or eliminated by focussing attention on organisational/institutional policy implementation and enforcement of these critical mitigation strategies.

III. A strong relationship was observed to exists among latent variables of mitigation strategies of construction delay of roads in the Niger Delta Region of Nigeria. These are relationships between: preventive measures and predictive measures with a p-value of 0.006: predictive measures and corrective measures with a p-value of 0.014, and preventive measures and corrective measures with a p-value of 0.043. A conceptual Relationship Influence Zone triangle was generated.

IV. Structural Equation Modelling (SEM) functionality is better than the first generation block of multivariate techniques in analysing the cause-effect relations between latent constructs [6]. These multivariate analyses techniques could have thrown-up the five or six most important mitigation strategies identified in Table 3 as critical. And such conclusions would be impaired by partial selection of clustered mitigation factors or strategies from the same stratified groups.

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