Check the Sensitivity of Cost Parameters in Construction Projects Using Deterministic Model

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Abstract

The deterministic model was built to check the sensitivity of the impact of standard cost on the cost and demystification was carried out at the beginning (Delphi rounds and Likert scale) to determine the most important parameters, the Fuzzy Analytical Hierarchy Process (FAHP) to arrange and finally verify the parameter using FDM for the purpose of comparison with reality In practice, the most important parameters were used and applied in 100 construction projects, calculating importance weights, and then using the deterministic model model to verify the extent of their impact in preparation for predicting the mathematical model of cost parameters.

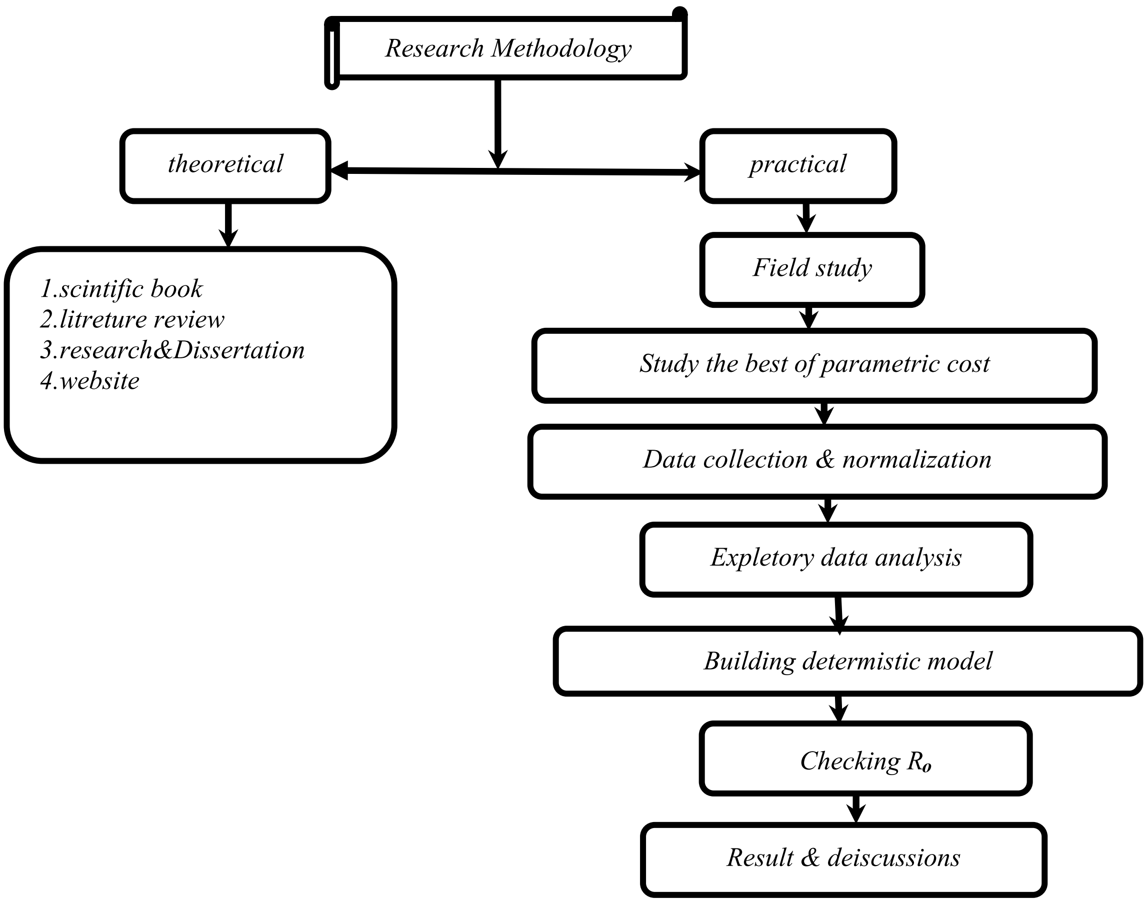
Keywords
Parametric Cost, Deterministic Model, Sensitivity Index

1. Introduction
Many research gaps require familiarity with typical costs. The difficulty is to find the most relevant knowledge of the initial standard cost that has the greatest impact on the final cost of the project to cover all components of the estimate. For any new guesswork in the conceptual cost model, these parameters must be quantifiable. It is difficult to estimate costs conceptually. It happens at the beginning of a project when there is too little information and too many variables to consider. It is not known how this might affect project costs. Conceptual cost estimation occurs in every project planning and feasibility research and, as a result, can have a significant impact on the overall construction budget. Estimated cost of the project. The evaluation of total costs is known as conceptual project costing, and it is based only on early general concepts of the project. One of the most important tasks in creating a parametric cost model is to identify the inputs. On the other hand, poor selective input may have a detrimental effect on the performance of the proposed model. As a result, expert opinions may help decision makers in determining standard cost. When it comes to identifying the primary cost components of a project, most researchers turn to the literature. In general, if there are no costly drivers, the aim of this study is to determine a standard cost of construction projects that can be used as a benchmark. The determination of cost parameters is necessary. Incorrect determination of the cost parameter leads to wrong marginal cost model and inaccurate cost prediction. As a result, determining the exact cost parameters is a challenge. An important step forward in developing a trustworthy integrated model for conceptual costing.

1.1 Objectives
The Objective of the study is to Check the Sensitivity of Cost Parameters in Construction Projects Using Deterministic Model for developing an integrated Model by Artificial Intelligence and parametric construction cost estimate

2. Methods

The aim of this study is to study the reality of the standard cost of construction projects and then use it in an integrated predictive model to determine and evaluate the sensitivity of parameter costs affecting the cost of construction projects and then verify it as the study tries to add to the field of knowledge for researchers, academics and project owners alike about how Reducing their risks or mitigating the effects of the parameters affecting the cost of the project Figure 1



4. Data Collection

The questionnaire process included a sample of engineers in construction projects in the public and private sectors. The questionnaire was distributed to (100) construction projects for the various governorates of Iraq, as they are filled out by the competent authorities. The questionnaire included (17) basic specialized questions for the experienced category (15-25) based on the answer to one of the options listed in the questions with only one reference, so that the answer is specific to the required questions. The possibility of evaluating the impact and gets Estimated Weight from (Spss-v22) and uses it in deterministic model. Table 1 show that

Table 1. Definition of parametric cost

Symbol		Definition of parametric cost (PC)	Estimated Weight from Spss
P_1	ʐ	Year of construction	*0.122*
P_2	$ʂ_t$	Scope of work	*0.061*
P_3	$ɾ_{1t}$	Escalation if any	*-0.089*
P_4	$ɾ_{2t}$	Size of project	*0.0155*
P_5	μ_c	Inflation rate	*0.211*

P_6	**Λ_c**	Contingencies	*-0.001*
P_7	**$ά_c$**	Cost Data for Similar Work	*-0.2574*
P_8	**λ_{ci}**	Work of circumferences	*0.18*
P_9	**β_{co}**	Constraint (policy and security)	*0.00*
P_{10}	**ɀ̌ₒ**	Consultant performance and errors in design	*0.291*
P_{11}	**λ_{vp}**	Indemnity and insurance	*0.293*
P_{12}	**ʃ$_{vp}$**	Change order	*-0.225*
P_{13}	**β_{pr}**	Procurement (import or export)	*-0.071*
P_{14}	**ῡ**	Equipment (Size, availability and complexity)	*-0.161*
P_{15}	**Ὠ**	Labor (Type of test)	*-0.387*
P_{16}	**ῷ**	Type of contract	*-0.094*
P_{17}	**$ṅ_c$**	Changes in standards or specifications	*0.41*

4.1 Building up the Deterministic Model:

The main reasoning lies in (deterministic model) to transform the input space into a high-dimensional space through non-linear transformation, information extraction, and regularity in data. Thus, in high-dimensional space, there is a non-linear relationship between the input and output variables. The deterministic model is distinguished from other methods by achieving high accuracy by relying on the cost parameters whose weights were extracted from Table [1] and then knowing their sensitivity and according to the following derivation As the parametric costs were encoded in the equations and derived as they are included in the construction project and the relationships between them were found for the purpose of knowing the sensitivity of this model through Reproduction number Sensitivity index (R_O) and this is explained as follows:

$R_O \leq 1$ (Stabilizes Model to the parametric cost)
$R_O > 1$ (Un Stabilizes Model to the parametric cost)

T(PC)= ɀ-T(ʃ1+ ʃ2)+ şT
C(PC)= T(ʃ1+ ʃ2)-C(λ+Λ+ά)
CO (PC)= λC- βco
P(PC)= ɀ̌ -P(λ+ ʃ)
Pr(PC)= λp+ βpr
Ci(PC)= άc- λci
ʃ = ʃ1+ ʃ2 Assign
So : T(PC)= ɀ-T ʃ + şT
C(PC)= T ʃ -C(λ+Λ+ά)
ʃ1=(ῡ*Ὠ)/(CI)
ʃ2=(ῷ*C(PC))/CI
λP=ṅc/CI
T+C+CI+CO+Pr+P=
CI =T+C+CO
T=0 = T(PC) , C=0 = C(PC) , CO=0 = CO (PC) , P=0
P(PC), Pr=0 = Pr(PC), CI = 0 = CI(PC)
are initial values notations. Ὠ is an expression in ῡ, ṅc and CI
T(PC)= ɀ-T (ş +(ῡ*Ὠ+ῷ*C(PC))/(T+C+CO))
C(PC)=((ῡ*Ὠ+ῷ*C(PC))/(T+C+CO)+ş)T-C(λ+Λ+ά)
CO (PC)= λC- βco
P(PC)= ɀ̌-P(1/(T+C+CO)+λ)

Pr(PC)=1/(T+C+CO)-βpr
CI(PC)= άc- λci

4.2.Equilibrium Point and Basic Reproduction Number

This method has been used to model. evaluate the basic number of the

$$RO = \frac{1}{2}\left(\mathbf{k1} + \sqrt{\mathbf{k}_1^2 + 4\mathbf{k}_o}\right)$$

$\mathbf{k_1}=\frac{\grave{\Omega}}{\bar{\upsilon}+\text{ʃ}}$ $\quad$ $k_o=\frac{\text{ʃ}*\text{ʐ}*\tilde{\varpi}*\dot{n}c}{(\bar{\upsilon}+\text{ʃ})\lambda vp*\check{\text{ʐ}}}$Since CI =T+C+CO following can be deduced from the model

Since CI =T+C+CO following can be deduced from the model

$N=P+P_r$

$N_{(PC)}=$ ʃ- ş_T

$N_{(PC)}= \lambda_p - \beta_{pr}$

The system {4} of different equations implies that the model {3}is in R_+^6 and from latter D is a subset of R_+^6 such that

D={T,C,CO,P,Pr,Ci} Ɛ R_+^6| T+C+CO | ≤ $\frac{\text{ʐ}}{St}$, P+Pr ≤ $\frac{\check{\text{ʐ}}}{\lambda vp}$,Ci≥0}

Therefore, the condition to be considered is only that the model (3) is in D. That the system in D is bounded in non-negative region. In order to obtain the equilibrium point, LHS of every equation in system (3) is set to zero, thus reducing the system to

$\text{ʐ}= T\left(\text{ş} + \frac{\bar{\upsilon}*\grave{\Omega}+\tilde{\varpi}*C(PC)}{T+C+CO}\right)$

$C(\lambda+\Lambda+\acute{\alpha})=\left(\frac{\bar{\upsilon}*\grave{\Omega}+\tilde{\varpi}*C(PC)}{T+C+CO}+\text{ş}\right)T$

$\lambda_C= \beta_{co}$

$\check{\text{ʐ}}=P\left(\frac{1}{T+C+CO}+\lambda\right)$

$\beta_{pr} =\frac{1}{T+C+CO}-$

$\acute{\alpha}_c= \lambda_{ci}$

=T+C+CI+CO+Pr+P

$=\text{ʐ}-T\left(\text{ş} +\frac{\bar{\upsilon}*\grave{\Omega}+\tilde{\varpi}*C(PC)}{T+C+CO}\right)+\left(\frac{\bar{\upsilon}*\grave{\Omega}+\tilde{\varpi}*C(PC)}{T+C+CO}+\text{ş}\right)T-C(\lambda+\Lambda+\acute{\alpha})+\lambda_C\,\beta_{co}+\check{\text{ʐ}}-P\left(\frac{1}{T+C+CO}+\lambda\right)+\frac{1}{T+C+CO}-\beta pr+\acute{\alpha}_c-\lambda_{ci}$

$$\mathbf{R_o}=\frac{1}{2}\left(\frac{\grave{\Omega}}{\bar{\upsilon}+\text{ʃ}}+\sqrt{\left(\frac{\grave{\Omega}}{\bar{\upsilon}+\text{ʃ}}\right)^2+\frac{4*\tilde{\varpi}*\dot{n}\boldsymbol{c}*\text{ş}\boldsymbol{t}*\check{\text{ʐ}}}{(\bar{\upsilon}+\text{ʃ})*\text{ʐ}*\boldsymbol{\lambda vp^2}}}\right)$$

Sub table (3-7) in :

$$R_O=\frac{1}{2}\left(\frac{-0.387}{-0.161+(-.089+0.0155)}+\sqrt{\left(\frac{-0.387}{-0.161+(-.089+0.0155)}\right)^2+\frac{4*-0.094*0.41*0.061*0.291}{(-0.161+(-.089+0.0155))*0.122*0.293^2}}\right)$$

$R_O \leq$ 1 FOR 10 Construction Project (Stabilizes Model to the parametric cost)

5. Results and Discussion

Regarding parametric costs Form in DFE points in the Fig [1] can pose any threats Because it seems that it can be controlled if $R0 \leq 1$. i.e. maximizing the recovery rate, and Minimize all unsafe parametric costs Weights were taken from 10 construction projects and calculated as an example For simulation, found with $R0 \leq 1$.After drawing the simulation diagram with the extracted weights Equilibrium (DFE) justifies two different sets of eigen values from the characteristic equation in DFE point. These sets of eigenvalues are Variation functions in some parameters. All A set of its eigenvalues Specific point of DFE. one of the Two sets of eigenvalues simply occur in one Point to the variable parameter. There is only one type of behavior From the DFE where the six domestic DFE point subjective values .The simulation results are that the parametric parameters grow Only when it is R0 $\leq$ 1. The important finding in this model is that $R0$ is Most sensitive to recovery rate followed by therefore, Although specific sensitivity to the effect is known It can help Take precautions in addition to handling The effect of parametric parameters on the cost of the construction project . Fig [1] show that:

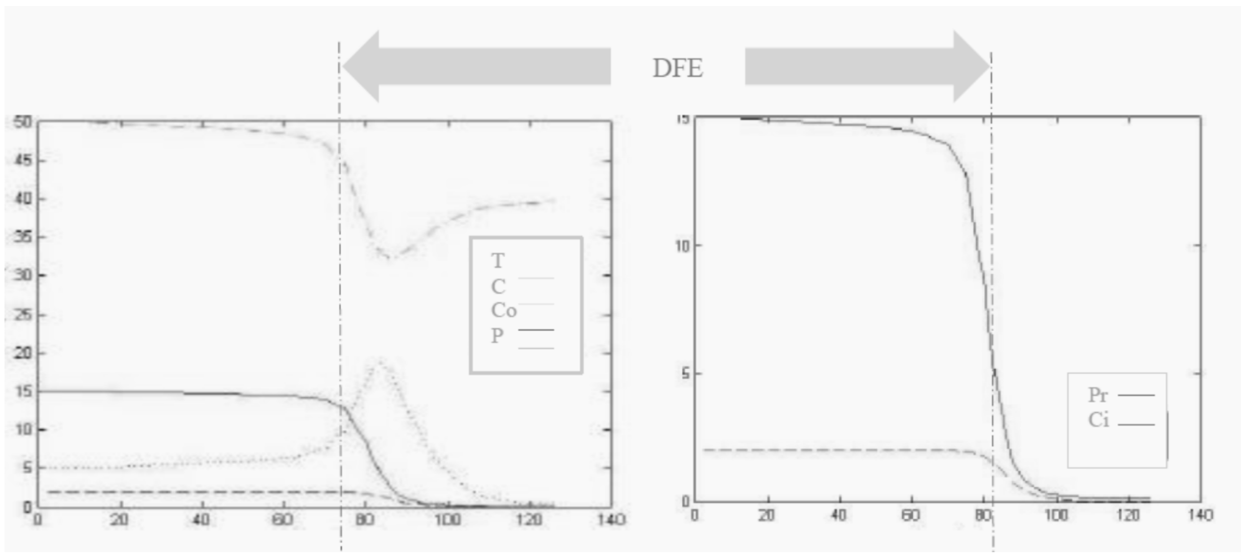


Figure 1. Dynamics DFE Point when $R0 \leq 1$

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