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Value integrated project delivery model using IPV technique

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ABSTRACT

One of the most efficient ways to enhance project performance by managing project cost, time, and quality issues is by integrating value engineering technique (VE)with the integrated project delivery method (IPD). This research aims to determine the relative importance of each criterion that impacts the project's performance and next step is to develop a mathematical model that accounts for these factors.

The researcher got to find the common factors between the value engineering technique and the IPD method through a closed questionnaire for experts in the field of value engineering. The weights of the main and sub-criteria were found using the IPV technique, which is appropriate for decision-making. The researcher found that the main criterion of (time management t)ook the most significant percentage (22%) of the project's performance, followed by (risk management) at 17.5%, and so on for the rest of the criteria. Through the application of multiple regression, it was observed that there are strong relationships between the performance of the project, which is the dependent variable, and the nine independent variables, and the researcher was able to reach the mathematical model

Keywords: Integrated project delivery, value engineering, IPV technique, project performance .

1. Introduction

The method uses pairwise comparison to separate a complex unstructured situation into its component parts, arrange those parts into a hierarchy, assign numerical values to subjective judgments regarding relative importance (or preference), and provide a new perspective on multi-criteria decisions and alternatives by viewing its main decision criteria as non-directed (numerical). Changes in sub-criteria only affect the main criteria. By viewing its primary decision criteria as non-directed, the Inner Product of Vectors (IPV) method offers an alternative viewpoint on dealing with multi-criteria decisions and alternatives

(Numerical) Additionally, the main criterion's size is not impacted by the change in sub-criteria. Alternatives in the decision-making process are viewed as vectors in this method procedure, such as deciding how to prepare a work in progress project according to time, money, and quality standards. Many difficult issues were resolved with the help of this method, which ultimately streamlined the choice-making procedure. Expert opinion was used in this paper to determine which criteria would best effect to the value engineering. It helps decision makers by including all criteria and factors, tangible or intangible, that influence good decision making **(Hafth and ahadi , 2015).**

This method uses decision alternatives as vectors to show the vectors in the decision-making process, such as choosing a model project based on cost and quality. This method has solved many complex decision-making problems **(Ali,2022).** problem comprehension IPV addresses complex technological, economic, and sociopolitical issues problems. By simplifying and accelerating up natural decision-making. Previously, interviews with experts and statistical analyses were used to identify the main and sub-criteria of integrated project delivery and value engineering. The main aim is to identify the IPD factors' impact on VE and which sub-criteria need to be analyzed, Identify the weight main and sub-criteria that need to be analyzed and considered for a mathematical model and identify a mathematical model that expresses the relationship between variables. This study allows to understand the current state of the Iraqi communication sector.

2.METHODOLOGY

1.An open questionnaire to collect information from a team of experts in the field.

2. Closed questionnaire to gather the data from the open questionnaire and theatrical study

3. Weighing each criterion using the IPV method

4- Create a mathematical model integrating IPD with value engineering for the communications sector.

2.1 Structure of the questionnaire

First, relevant information was collected, organized, and analyzed from previous studies. After that, discussions, analyses, and modifications created a questionnaire. The questionnaire's contains research-related information. The questionnaire was two-part. The first section includes general information about the entity (type and name) and the target community's questionnaire respondents (specialization, educational qualification, workgroup, and experience). The second part lists factors that may positively impact VIPD in communication sector This section has 9 main axis include 183 closed questions with five-point Likert scales **(Salkind, 2010)**

as shown in **Table 1.** Based on their perceptions of the Iraqi communication sector, respondents were asked to evaluate each factor.

Table 1. Likert scale

Symbol	Meaning
1	No effect
2	An inadequate grade
3	Medium effect
4	high level
5	Very high level

2.2. Statical analysis

Table 2. below show the results of the statistical analysis of the questionnaire data, which showed 23 factors with a relative importance of 0.7 or higher to be the most significant

Table 2. Final list of criteria with statical analysis

Category	Sub-criteria	Mean	Std. Deviation	RII
Scope	provide the project's information in detail	4.5455	.50119	0.9091
	Define the project's strategy, timeline, and parameters.	4.4935	.50324	0.8987
	Honesty and specificity in congratulating work	4.4286	.49812	0.8857
Time	The team's flexibility in planning project tasks	4.5065	.50324	0.9013
	Manage relationships between project team members	4.4545	.85140	0.8909
cost	Define the cost of project work items and project performance to create a budget.	4.4805	.50290	0.8961
	required level of work quality	4.0130	.80285	0.8026
	Create a contingency plan for the costs associated with potential work quality issues.	3.8312	1.17432	0.7662
quality	The benefits of a quality culture, both material and moral, can be shared throughout an organization and made apparent to its participants.	4.0779	.77402	0.8156

	Regular monitoring and analysis of performance in service of continue to improve	3.8571	.78997	0.7714
Human Resources	promoting Project-specific Training and Kickoff Meetings	4.5714	.52387	0.9143
	The work team's administrative skills and using various means of communication	4.5714	.49812	0.9143
	The management team's opinions and discussion of possible solutions.	4.0909	.78106	0.8182
	Facilitating communication between internal team members and external stakeholders	4.0000	.79472	0.8
communication	Determine who has influence and what role they play in the project and list them.	4.5714	.49812	0.9143
	Define times for contact within the standard workday	3.4935	1.20986	0.6987
risk	Awareness among stakeholders for the importance of risk research and analysis	4.4935	.50324	0.8987
	Clearly outlining the limitations and requires of using risk assessment.	4.0909	.83006	0.8182
procurement	Managing and scheduling agreements in a way that protects the interests of all parties with respect to delivery times and specification compliance	4.5584	.49983	0.9117
	the never-ending quest for knowledge about the most effective materials and production methods	4.4286	.49812	0.8857
Stakeholder	Identifying the appropriate level of stakeholder engagement, which may include things like researching and questioning concepts	4.5584	.49983	0.9117
	Identify and vary the different groups of stakeholders	4.4805	.50290	0.8961
	The group's history of working on similar projects	4.4286	.49812	0.8857

2.3 IPV Tanique procedure

Comparing alternatives to achieve multiple and competing goals is becoming increasingly important in nature conservation decision-making, such as the protection of habitats, the support of vulnerable communities, and the promotion of economic growth **(Adem and Geneletti., 2018).** After achieving the most important standards, we proceed to the next stage, which includes extracting the weights of these standards to show the degree of their impact on project performance using a series of procedures within a technology as shown in **Fig. 1**.

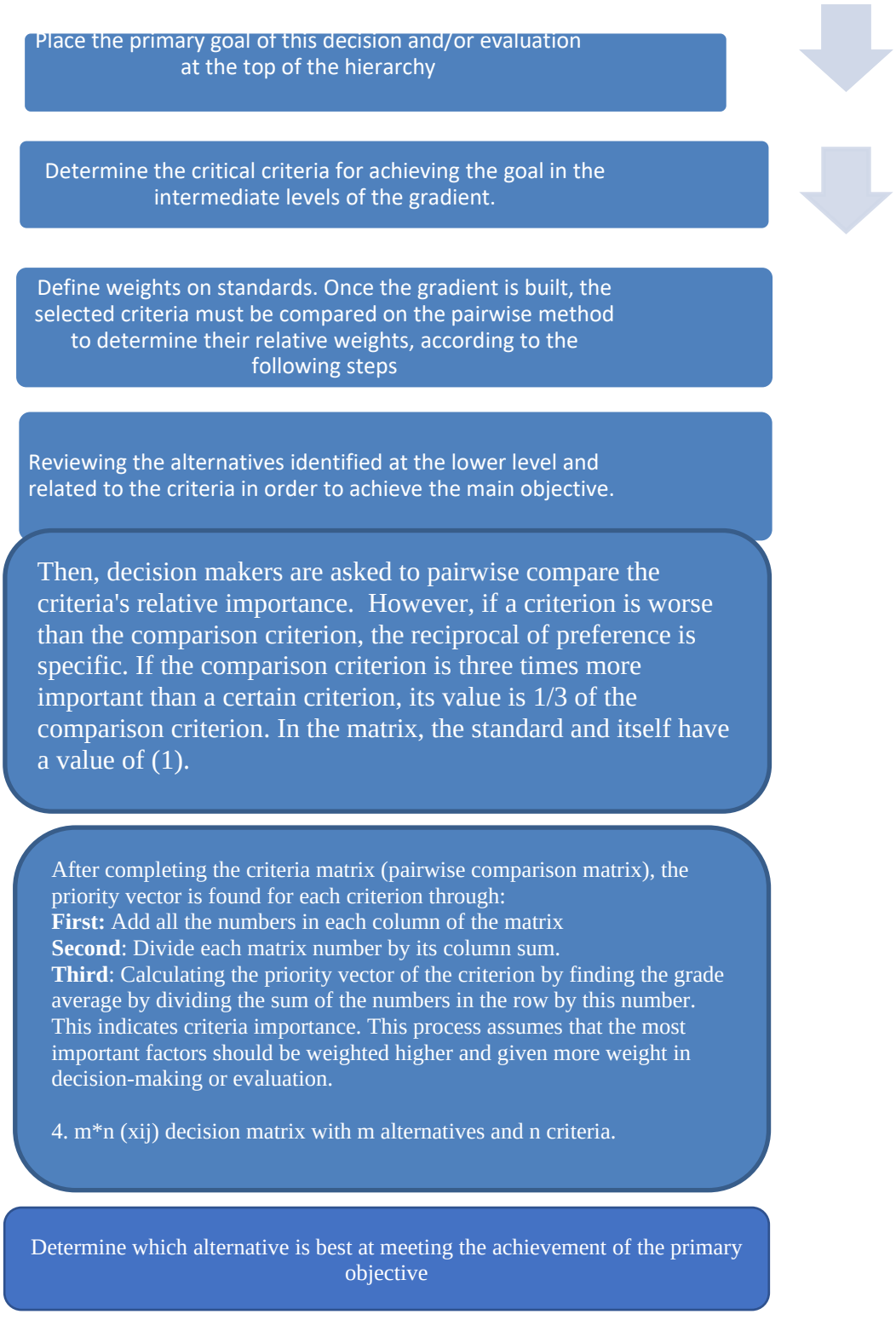

Figure 1: IPV procedure **(Raafat, 2021)**

2.4. The role of the expert in the questionnaire

1-Establishment the compare pairwise matrices for experts

2-Evaluate main and secondary criteria in pairwise comparisons

3- Create IPV technique questionnaires

4- Sends out questionnaires to professionals

5-collect the questionnaires answer

6-Mathematical analysis of the questionnaires

2.5 Experts' distribution

The questionnaires have been delivered to professionals with experience in value engineeringand integrated project del ivery.

total of nine (9) specialists from variou s fields were sent

questionnaires by the researchers.

Table (2) displays the sample populati on. According **to (Senthil and Jaheerhussain, 2010)** the Likert scale of IPV technique as shown in **Table 4**

Table 3: Final list of criteria

Academic Credentials	No	Specialization	Years of experience
Ph.D.	1	Network engineer	25year
MSc.	3	Civil engineer	More than 20 years
High diploma	2	Civil engineer	
BSc.	3	Civil engineer	

Table 4: IPV Likert scale

Weight of significance	Definition
1	Equal value
3	intermediate
5	Crucial significance
7	Extremely vital significance
9	Vital significance
2,4,6,8	Values in the middle

From a behavioral standpoint, criteria with higher activation possibilities have a significant impact on drivers' route choice behavior. We provided a method to assess the criterion weights for determining the route-selection criteria because the importance of the criteria is the critical key to controlling the influential criteria in formulating a route. Our proposed method does not require criteria independence.

Instead, the interrelationship of criteria can be accurately described **(Chen et al., 2001)**

3. IDENTIFY THE WEIGHT OF CRITERIA

The researcher followed the steps outlined in Table **2.** to identify the IPD criteria affecting value engineering, then compared the main and sub-criteria head-to-head using a Likert scale, achieving the following result.

Table 5. show that the highest weight at 25.4% to (Scope management), followed by the (Stockholders management) with 17.3% in value, and so on for the rest of the variables.

Table 5. Weight of Main and sub criteria

Main Criteria	Symbol	Weight	Sub criteria	Local weight
Scope management	SM	2.5%	SM1	41.10%
			SM2	26.10%
			SM3	32.80%
Stakeholder management	S	3%	S1	54.80%
			S2	24.10%
			S3	21.10%
Communication management	CM	16.5%	CM1	66.70%
			CM2	33.30%
Risk management	RM	17.5%	RM1	75.00%
			RM2	25.00%
Human Resources management	HM	3.45%	HM1	23.90%
			HM2	29.50%
			HM3	25.40%
			HM4	21.20%
Quality management	QM	8.20%	QM1	75.00%
			QM2	25.00%
Time management	TM	22%	TM1	66.70%
			TM2	33.30%
Cost management	CM	11.07%	CM1	45.50%
			CM2	32.06%
			CM3	22.50%
Procurement management	PM	15.78%	PM1	75.00%
			PM2	25.00%

4. MATHMATICAL MODEL

4.1 Standardized model

Depending on the above weights value, the project performance equation will be as follows.

Performance VIPD = 2.5 (SM)+ 3 %(S) + 16.5% (CM) + 17.5% (RM) + 3.45% (HM) +8.20 % (QM) + 22% (TM) + 11.07 % (CM) + 15.78% (PM)…… (1)

By Researcher work with IPV technique

4.2 Estimate model from multiple regression

According to **(Wong etal., 2006)**. The statistical method of multiple regression helps study the correlation between one dependent variable and many potential independent ones. The point of using several

Regression analysis aims to predict the value of a single dependent variable based on the known values of a set of independent variables. The relative importance of each predictor value is indicated by the weights assigned to those values.

Y = a + b 1X 1 + bzX 3 +... + bnX n …….... (2)

Y: is the dependent variable
X 1 ...., X n are the n
independent variables.

In calculating the weights, a, bl .... , bn, regression analysis ensures maximal prediction of the depend-ent variable from the set of independent variables.

To perform a multiple regression analysis, data from 15 separate project (case study) were gathered .by using program SPSS26 to analyze raw data. The results are as shown in the **Table 6.**

Table 6. Weight of Main and sub criteria

Coefficients							
Model				Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B
				Beta			Lower Bound
1	(Constant)	-31475.545	1668.810		-18.861	0.000	-35765.357
	Scoop	489.312	83.356	0.189	5.870	0.002	275.038
	Stakeholder	717.624	55.516	0.438	12.926	0.000	574.915
	Communication	3253.754	330.968	0.181	9.831	0.000	2402.972
	Risks	3786.998	318.725	0.219	11.882	0.000	2967.690
	HR	780.031	52.215	0.442	14.939	0.000	645.809

	Quality	1656.972	249.560	0.143	6.640	0.001	1015.459
	Time	-4398.844	962.506	-0.259	-4.570	0.006	-6873.045
	Costs	-2350.198	463.271	-0.136	-5.073	0.004	-3541.075
	Procurement	3353.205	944.547	0.197	3.550	0.016	925.171
a. Dependent Variable: Costs							

Performance (VIPD) = -31475.5 + 489.312* SM + 717.624* S + 3253.75* CM + 3787.0* RM + 780.031* HM + 1656.97* QM - 4398.84* TM - 2350.2* CM + 3353.21* PM…… **(3)**

4. RESULT

Through the results in Table 5, the weights of the primary and secondary criteria were extracted, and it was found that the primary criterion (time management) had the highest weight (22) of the project performance, followed by (risk management) with a weight of 17.5, as well as the rest of the weights.
The researcher has calculated the multiple regression equation in two ways,
First using summation of the weights multiplied by the unit of measure for each standard and secondly by using SPSS v26 program through input date for 15 projects (case study)
And once through the statistical program and Table 6, it was shown that all criteria were included in the linear relationship

5.CONCLUSION

A strong direct relationship can be seen with all variables except time and cost, for which an opposite relationship was found
The market for labor needs to adopt new administrative approaches that are in step with technological advancements and reflect the abilities of its participants.
Consider a study like value engineering, which provides a report on high-quality, cost-effective alternatives to the project's current situation, with input from those already well-versed in the field. When implemented properly, integrated project delivery may decrease costs, improve efficiency, and increase profits in all levels.
The mathematical connection that the researcher establishes can be used to determine the optimum project performance.

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