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Global Post-Evaluation for Highway Construction Projects

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ABSTRACT

The Post-project evaluation in highway construction is crucial but underdeveloped in infrastructure management, especially for Iraqi road project authorities. This comprehensive study combines insights from global schemes in England, Scotland, France, Australia, Norway, and New Zealand to develop a strong post-evaluation framework .This study used criteria from six international schemes, a thematic analysis framework, and open interviews with experts to identify and improve the final list of criteria that could be used in the evaluation process. Five criteria were identified as the final result, which are efficiency (cost, time, and quality), traffic analysis (volume, travel time, and impact), safety (accidents and security), sustainability, and impact (economic and social). Then, to develop a multiple regression model for the success of a project, criterion weights were derived through the utilization of the Inner Product Vector (IPV). This study emphasizes the need for a comprehensive post-evaluation framework, especially in complex highway construction. A milestone is reached when international standards and careful variable extraction are combined. Based on empirical data and expert judgment, the mathematical model simplifies assessment and predicts project success, giving stakeholders a systematic, impartial, and comprehensive evaluation tool.

Keywords: Highway, Post-evaluation, Assessment, Mathematical model, Project management.

1. INTRODUCTION

Construction is a crucial economic sector that advances nations. It has traditionally been a key indicator of economic growth **(Alzahrani et al., 2013)**. The construction industry differs from others in its procedures, project management, work environment, conditions, and worker behaviour **(Fang et al., 2013)**. (**Meng, 2012)** agreed with (**Guangshu et al., 2009)** that construction projects are important. These projects are crucial because they affect society's need for high-performance services.

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Therefore, Highways connect multiple municipalities as public transportation infrastructure. Since highways boost economic activity, they are considered essential to national development **(Ismael et al., 2016; Sarsam et al., 2023)**. Highways help meet local demand by transporting people and goods quickly **(Högselius et al., 2016; Afrawee et al., 2020; Mahdi et al., 2023)**. Highway projects are considered high-risk because they affect a country's economic, sociological, and political development **(Donaldson, 2018)**. Successful projects must meet specific criteria, such as meeting timelines, budgets**(Azeez et al., 2023)**, goals, and objectives, and minimizing environmental impact **(Wibowo et al., 2015)**. Consequently, it is unsurprising that many nations invest heavily in their transport networks to improve their quality of life. The US spends over USD 9 trillion on highways and transportation **(Winston et al., 2018)**. Assessment is necessary for keeping things under control **(Chang et al., 1998)**. Indeed, "what gets measured gets done" **(Ledbetter, 1994)**. The achievement of the project can be measured using performance measures developed from prior studies that identify desired outcomes **(Chan et al., 2002)**. According to (**Lim et al., 1999)**, criteria are "set of principles or standards by which judgment is made and are considered the rule of the game". Every endeavor—including construction—has achieved performance. Measurement is difficult because project success is intangible and cannot be agreed upon by all stakeholders throughout the project life cycle. Thus, objective project performance measurement is a delusion **(Chan et al., 2002; Jha, 2013)**. Popular project performance measures include the 'iron triangle' time, cost, and quality **(Atkinson, 1999)**, according to the extent of matching the owner's expectations **(Burhan, 2022)**. Various project performance metrics have been proposed. Objective or subjective performance metrics. While time, cost, quality, safety, and dispute are objective performance metrics, customer satisfaction, contractor satisfaction, and project management team satisfaction are subjective **(Jha, 2013)**.

The construction industry is complex due to the involvement of clients, contractors, consultants, stakeholders, stockholders, and regulators. The above entities affect project performance, which is measured by time, cost, quality, customer satisfaction, productivity, and safety **(Seninde et al., 2021)**.

Thus, evaluation definitions have evolved. The study uses two definitions. The (**OECD, 2022)** defined evaluation as "A systematic and objective assessment of an ongoing or completed project, program or policy, its design, implementation, and results". Second, (**Scriven,1991)** defines evaluation as "The process of determining the merit, worth, or value of something."

Post-project evaluation is an objective assessment of the project's conception, implementation, benefits, role, and influence. Through a detailed summary and assessment of project behaviour **(He et al., 2020)**, determine if the project planned target was met, lessons learned, and project information, provide timely and effective feedback for future new project decision-making and improve project investment decision-making management to provide experience for reference and propose project problem solutions.

Post-project evaluations are crucial to beneficiary interests. Their importance is enhanced by their alignment with development goals **(Gupta and Seth, 2010)**.

The post-project evaluation should evaluate the indicators created during planning, according to **(Enshassi et al., 2014)**. This review includes economic assessments of actual and expected expenses, quality, effectiveness, safety, and environmental impact .

A comprehensive project performance evaluation framework must consider quality, owner satisfaction, and environmental impact. These components affect engineering project evaluation, according to **(Guangshu et al., 2009).**

Post-project evaluation informs organizations about project outcomes and performance and promotes continuous improvement. We learn from our mistakes and avoid repeating them. The process improves decision-making by providing data-driven insights, engaging stakeholders, and building trust. It also mitigates risks and supports organizational learning by capturing and sharing project lessons, driving innovation and improvement **(Anbari et al., 2008)**.

In the post-project evaluation process, data is collected, success criteria are assessed, lessons for future projects are extracted, data accuracy is verified, results are documented, and information is shared for reference and application **(Altuğ, 2002)**.

To control the date and scope of post-evaluation evaluations, stakeholders' intentions, objectives, and resources determine the time. Post-evaluation occurs in social time. Social negotiation among key stakeholders determines post-evaluation timing **(Müller et al., 2011; Hanisch et al., 2014; Müller et al., 2007)**. Evaluations are usually done 1-2 years after policy or project completion **(Welde et al., 2018)**. Since 2002, the UK's POPE scheme has evaluated major road investments at 1, 5, and 10-year intervals, with limited 10-year appraisals **(Highway, 2015)**. The Internal Transport Act 1982 in France requires post-evaluations of major transport projects five years after opening **(Meunier et al., 2017)**. Post-evaluations occur for 15% of European Investment Bank projects **(Kelly et al., 2015)**.

Post-project evaluations, situated in the "analyze" phase post-project completion **(Lientz et al., 2007)**, employ two main approaches: self-evaluation by project teams (quick and cost-effective, yet subjective) and evaluation through designated departments (more thorough, objective, but suitable for larger projects). Responsibility for evaluation lies with project members, a project support office, consultants, or a specialized department based on the process structure. Dedicated departments, led by evaluation teams and consultants, often oversee the process with support from project leaders.

When feasible, some projects establish post-project evaluation sessions, including technical personnel, management, sales teams, and customers. Key participants generally involve the project team, project office, stakeholders, and end-users **(Murphy, 1997; Whitten, 2000).**

The highway construction environment in Iraq lacks a post-evaluation system based on specific criteria. This study was for the purpose of enhancing the effectiveness of highways and helping decision makers draw inspiration from lessons learned.

The scope of the research was focused on highway projects in Iraq and their evaluation based on criteria extracted by scholars from international plans. The main objectives of this research:

1- Determine the criteria by which Iraqi highways could post-evaluated in similar way like international schemes.

2- Creating a linear equation that helps decision-makers in the post-evaluation of Highway projects.

2. METHODOLOGY

This study applies an integrated approach to the post-evaluation of highway projects, incorporating lessons learned from Six global schemes in England, Scotland, France, Australia, Norway, and New Zealand. The aim is to simplify the variety of requirements to a manageable level that captures the essential elements of successful road projects. This procedure involves employing strong metrics working together with the cooperation of experts.

Selection of International Schemes: Six international schemes of post-evaluation highway from England, Scotland, and France, Australia, Norway, and New Zealand **(Highway Agency, 2015; Transport Scotland,, 2016; Meunier et al., 2017; Dotars, 2007; New Zealand Transport Agency, 2014)** are carefully chosen in the first stage. These schemes operate as benchmarks for guidance in understanding the various approaches and standards used in various situations. The choosing of these six international schedules is that it is available, and that the researcher was able to obtain, and it is close to the Iraqi road system and has the same scientific background.

Identification and Refinement of Criteria: To identify the most important criteria, a group of highway engineering and project management experts will be assigned to rate and rank the criteria from the selected international schemes. Brainstorming of six phases was applied for theme analysis. The first stage is data familiarization. Interviews were transcribed and examined, and preliminary ideas were noted. Second, develop start codes. Themes are identified using initial codes in phase three. The fourth phase is subject review. Step five is identifying and defining aspects. Reporting analytical findings is the sixth and final step. The sample was chosen purposely and the number in the case of a field questionnaire must not be less than 30, and in the case of a brainstorming or focus group, it is possible to adopt a number between 4-8 because the problem requires experts in the field of highways **(Al-Samarraie and Hurmuzan, 2018; Rahman et al., 2020)**. The goal is to pinpoint the top five crucial factors that are representative of project success and broadly applicable. Iterative talks and careful evaluation of the applicability of each criterion are part of this process.

Criteria Weighing Using Inner Product Vector (IPV) Technique: In order to assign weights based on expert opinions, the identified criteria will be subjected to the Inner Product Vector (IPV) technique. This guarantees that, within the framework of highway projects, the criteria are not only recognized but also prioritized.

Multiple Regression Modeling: A multiple regression model will be used to quantify the relationship between the project's success and the identified criteria. To do this, estimated information from eleven different highway projects must be gathered from the managers of the projects, and a mathematical equation must be derived using statistical methods. Based on the prioritized criteria, the resulting equation seeks to offer a predictive tool for evaluating the likelihood that future highway projects will succeed.

By integrating global best practices, professional judgment, and statistical modelling to produce useful insights for the enhancement of future projects, this extensive methodology guarantees an exhaustive and systematic approach to post-evaluating highway projects.

3. RESULTS AND DISCUSSION

3.1 Evaluation Criteria

This study collects and summarizes data and criteria from six international schemes and then presents them to experts whose details are given in **Table 1** through open interviews, enabling experts to contribute their opinions and experience. Compared to the employment of survey questionnaires, implementing open-ended questions during these interviews fosters a conducive environment for experts to provide comprehensive and detailed information. The interviews start with an initial presentation of the subject, followed by a review of the criteria employed in global schemes **Table 2**. Following this, the specialist identifies the criteria relevant to road projects in Iraq, evaluates their appropriateness for the local construction conditions, and suggests modifications for enhancement.

Table 1. Experts' information.

Scientific Qualification	No.	Specializations	Experience
Ph.D.	5	2 Academic Staff + 3 Project Executive Manager	More than 20 years
M.Sc.	3	Management + 2 Road Engineer	
B.Sc.	5	3 Planning + 2 Road Engineer	

Table 2. Details of international schemes.

No.	Country	Transport sector	Title	Criteria
1	England	Roads	Post-Opening Project Evaluation (POPE) major scheme	Environment
				Safety
				Economy
				Accessibility
				Integration
2	Scotland	Roads	Scottish Trunk Road Infrastructure Project Evaluation (STRIPE)	Objectives
				Process
				Operational indicators
				Environment
				Safety
				Economy
				Integration
				Accessibility and social inclusion
				Cost to government
3	Norway	Roads	Etterprøving av prissatte konsekvenser av store projekter (post opening of monetised impacts of major projects)	Efficiency
				Effectiveness
				Impact
				Relevance
				Sustainability
				Value for money
4	New Zealand	Road, Tunnel, Busways	Post-implementation reviews (PIRs)	performance
				To deliver on time, within budget and to scope
				The realization of broader benefits
5	France	Road, rail, fixed link, port, airport	Loi d'Orientation des Transports Intérieurs (LOTI)	Efficiency
				Effectiveness
				Impact
				Relevance
				Sustainability
				Value for money
6	Australia	Highway	Ex-post economic evaluation of National Highway projects	benefits to road users (reduced travel time and vehicle operating costs)
				Construction costs and timing of the project
				economic benefits to the region (such as increased productivity and employment)
				Traffic analysis
				Accident rates
				Average accident costs

Using Braun and Clarke's six-phase thematic analysis framework **(Braun et al., 2006)**, experts analyzed selected international schemes in **Table 2** to identify the five most significant integrated criteria for post-project evaluation in highway construction projects, as shown in **Table 3**. The systematic exploration and identification of key evaluation criteria within the context of the studied projects were guided by a series of phases. These phases included (Familiarization with the data, generating initial codes, searching for themes, reviewing themes, Defining and naming themes, and producing the report).

Table 3. Final integrated criteria selected by experts.

No.	Main criteria	Symbol
1	Efficiency (cost, time, quality)	C1
2	Traffic analysis (traffic volume, travel time, impact)	C2
3	Safety (accidents, security)	C3
4	Sustainability	C4
5	Impact (economic, social)	C5

3.2 Weighing the Criteria by Inner Product Vactor (IPV) Technique

IPV (Inner Product of Vectors) systematically deals with complex choices. IPV guides users to the action that best meets their needs and matches their understanding of the problem, not the "perfect" strategy. Treating primary decision criteria as non-directional (numerical) and sub-criteria as affecting only gives a new perspective on multi-criteria decisions and alternatives. IPV technology has been extensively studied in many fields **(Noaman, 2022).**
Inner Product of Vectors (IPV) is a structured method for complicated choices. Instead, then prescribing a "correct" option, the IPV helps decision-makers identify one that fits their requirements and knowledge of the situation. IPV addresses complicated technical, economic, and socio-political issues. The natural decision-making process is simplified and accelerated **(Senthil and Jaheer hussain, 2010)**. The IPV Steps are:

A .Identify Goal: This study's main goal is for post-evaluate Iraqi highway projects and assist decision-makers.

B .Hierarchy of Decisions:

Top: First level the goal above (Primary objective).

Middle: The second level contains approximately (5) Major Criteria **Table 3**.

Bottom: The third level for alternatives of the criteria.

C .Determining the Weight Criteria:

C.1 :Produce (n*n) pairwise comparison matrices for experts; see **Fig 1.**

$$\mathbf{A}=\begin{bmatrix} 1 & a_{12} & \cdots & a_{1n} \\ 1/a_{21} & 1 & \cdots & a_{2n} \\ \vdots & \vdots & \cdots & \vdots \\ 1/a_{n1} & 1/a_{n2} & \cdots & 1 \end{bmatrix}$$

Figure 1. Pairwise matrix

C.2 :Decision-makers compare the criteria' relative importance. The decision-maker compares each criterion and rates each pair of criteria. To determine which criterion is preferred, the ordinal scale (1-9) is used, **Table 4** shows the information of experts (decision-makers).

Table 4. Information of experts (decision-makers).

No	Qualification	Experience	Workplace
1	Ph.D.	18	Department of Projects and Construction/ Baghdad University
2	Ph.D.	15	Department of Projects and Construction/ Baghdad University
3	Ph.D.	16	Al-Nahrain University
4	M.Sc.	15	Public authority for roads and bridges
5	M.Sc.	14	Department of Projects and Construction/ Baghdad University
6	B.Sc.	33	Al-Rasheed General Construction Contracting Co.
7	B.Sc.	28	Ashuor General Construction Contracting Company
8	B.Sc.	25	Ashuor General Construction Contracting Company

C.3 :Utilizing comparisons, determine priority vectors.
C.4 :Determine the average evaluated values. The average values from 8 experts are given in **Table 5**.

Table 5. Pairwise Comparison for Main Criteria from Experts.

Goal	C1	C2	C3	C4	C5
C1	1	2	3	1	2
C2	1/2	1	2	1	3
C3	1/3	1/2	1	1	2
C4	1	1	1	1	4
C5	1/2	1/3	1/2	1/4	1
∑	3.333	4.833	7.500	4.250	12.000

C.5 :Calculate weights for criteria:
C.5.1 :Calculate the summation of values of each column from **Table 5**
C.5.2 :Calculate the new value by dividing each value by the column total. See **Table 6.**

Table 6. Dividing Each Element

Goal	C1	C2	C3	C4	C5
C1	0.300	0.414	0.400	0.235	0.167
C2	0.150	0.207	0.267	0.235	0.250
C3	0.100	0.103	0.133	0.235	0.167
C4	0.300	0.207	0.133	0.235	0.333
C5	0.150	0.069	0.067	0.059	0.083

C.5.3: Calculate the row average for a criterion by dividing the total numbers in the row by the number of criteria, see **Table 7**

Table 7. The Row Average for Main Criteria

Goal	C1	C2	C3	C4	C5	Average Row
C1	0.300	0.414	0.400	0.235	0.167	(1.516/5) = 0.303
C2	0.150	0.207	0.267	0.235	0.250	(1.109/5) = 0.222
C3	0.100	0.103	0.133	0.235	0.167	(0.738/5) = 0.148
C4	0.300	0.207	0.133	0.235	0.333	(1.208/5) = 0.242
C5	0.150	0.069	0.067	0.059	0.083	(0.428/5) = 0.085

The result from this process represents the relative importance of the criteria that can be used directly to calculate the Global Post Evaluation Score (GPES) using Eq. (1):

$$GPES = 0.303(C1) + 0.242(C2) + 0.222(C3) + 0.148(C4) + 0.85(C5) \quad (1)$$

3.3 Multiple Linear Regression

Multiple regression analysis was used in this study to determine the existence of a relationship between the dependent variable and the independent variables **(Kisavi, 2019; ALFahham et al., 2020)**. Multiple regression analysis enables researchers to evaluate the strength of the relationship between a result (the independent variable) and dependent variables and the significance of each variable in the connection. The standard form of the regression equation is as follows in Eq. (2**) (Maulud et al., 2020)**

$$y = \beta_0 + \beta_1 x_1 + \cdots + \beta n x n + Error \quad (2)$$

y : The value of the Dependent variable.
β_0: The Constant or intercept
$\beta_1, \beta n$: Coefficients
x_1, x_n : The value of independent variables

To derive the multiple regression equation for the weight equation, data will be collected from 11 completed case studies conducted across various projects, as shown in **Tables 8 and 9**

Table 8. Projects Name (Case Studies).

No.	Project No.	Project Name
1	Project 1	Hillah-Kish highway, 12.8 km long
2	Project 2	The second corridor road project, 36 km long, “Ramadi-Haditha”
3	Project 3	“Doura-Youssoufia” highway, 14.5 km long
4	Project 4	Rehabilitation and development of Karbala-Najaf Road, the return corridor, 20 km long
5	Project 5	Construction of the second corridor of the Karbala-Ain al-Tamr road for land Hajj, 45 km long, the first stage
6	Project 6	Construction of the second corridor of the Karbala-Ain al-Tamr road for land Hajj, 45 km long, the second stage
7	Project 7	Construction of the third Fallujah Bridge
8	Project 8	Rehabilitation of Highway No. 1, Section 7 (Nasiriyah-Rmayleh)
9	Project 9	“Construction of the Arar-Anaza border road, 24 km long
10	Project 10	Maintenance of Al-Hur -Kamalia Road, 14 km long
11	Project 11	Rehabilitation of the “Section 9 Highway” from Abu Ghraib to Ramadi

Table 9. Estimated Data from Case Studies (GPES)

Project No.	C1	C2	C3	C4	C5	GPES
Project 1	0.75	0.78	0.83	0.60	0.73	0.41
Project 2	0.69	0.78	0.70	0.50	0.78	0.44
Project 3	0.72	0.81	0.93	0.20	0.90	0.41
Project 4	0.59	0.44	0.61	0.35	0.38	0.22
Project 5	0.52	0.69	0.64	0.10	0.64	0.35
Project 6	0.62	0.74	0.47	0.10	0.64	0.37
Project 7	0.79	0.84	0.88	0.75	0.88	0.42
Project 8	0.74	0.87	0.84	0.30	0.60	0.44
Project 9	0.71	0.60	0.80	0.20	0.45	0.30
Project 10	0.62	0.65	0.63	0.09	0.53	0.33
Project 11	0.69	0.84	0.91	0.50	0.80	0.42

From the information in **Table 9** and by analyzing the data in SPSS(V26) program, the normality test according to Shapiro-Wilk test, the results show that P-values are statistically significant (above 0.05), ensuring a normally distributed survey, as given in **Table 10**.

Table 10. Normality Test for Variables

Variables	Normality Value
(GPES)	0.212
Efficiency	0.198
Traffic Analysis	0.195
Safety	0.236
Sustainability	0.181
Impact	0.112

Furthermore, the correlation test shows correlation coefficient (A "correlation" is a statistical or mathematical relationship between two or more independent variables that shows significant variation, connection, or pairing (Akoglu, 2018))between the variables.
The results display that there is a significant relationship between global post evaluation score (GPES) and (Efficiency) with Pearson Correlation (0.876), (Traffic Analysis) with Pearson Correlation (0.804), (Safety) with Pearson Correlation (0.844), (Sustainability) with Pearson Correlation (0.760), and (Impact) with Pearson Correlation (0.785).
Therefore, The ANOVA table shows a statistically significant relationship between variables (95.0% Confidence level) because the P-value is less than 0.05. A 100% adjusted R-squared statistic used to compare models with different independent variables. The residuals have 0.00230 standard deviation, per the estimate's standard error. **Table 11** indicates that all variables have significance values below 0.05, so the model passes the multiple linear regression test.

Table 11. Coefficients of Multiple Regression**.**

Model		Unstandardized Coefficients		Sig.
		B	Std. Error	
1	(Constant)	8.610E-05	0.008	0.991
	Efficiency (C1)	0.274	0.017	0.000
	Traffic Analysis (C2)	0.257	0.011	0.000
	Safety (C3)	0.235	0.007	0.000
	Sustainability (C4)	0.139	0.005	0.000
	Impact (C5)	0.086	0.008	0.000
a. Dependent Variable: GPES				

Based on **Table 11**, the relationship between Global Post Evaluation Score (GPES) and other variables in a multiple linear regression model is:

$$GPES = 0.0000861 + 0.274(C1) + 0.257(C2) + 0.235\ (C3) + 0.139(C4) + 0.086(C5 \qquad (3)$$

This model can be used to evaluate highway construction projects in Iraq and help authorities evaluate project outcomes, manage risk, and use funds efficiently for future projects. It standardizes project success evaluation, promoting accountability and transparency. It also improves Iraq's infrastructure development by refining future project planning and execution.

Based on multiple regression analysis, the mathematical model serves as a predictive compass to evaluate the success path of upcoming highway projects.

The proposed model provides a systematic, impartial, and comprehensive tool for stakeholders and decision makers to evaluate project success. Furthermore, this study underscores the importance of post-project evaluations to encourage organizational learning, reduce risk, and enhance creativity.

This study mainly serves as a guide in the search for a uniform and flexible framework for road construction projects after evaluation. It provides a new framework for evaluating and guiding the success of upcoming projects in highway construction.

4. CONCLUSIONS

Complex construction projects, particularly highway projects, need a robust post-evaluation framework, which the Iraqi Road Authority does not now have. This study investigated complicated worldwide schemes and built a powerful mathematical model for highway construction projects post-evaluation. Exploring Australian, New Zealand, Scottish, French, English, and Norwegian literature and procedures.

This study's mix of worldwide standards and thorough extraction of the most important factors make it important. Based on project management and transportation engineering expertise, this research identified and refined essential needs. The evaluation was based on efficiency (cost, time, and quality), traffic analysis (volume, travel time, and effect), safety (accidents and security), sustainability, and impact (economic and social).

This research's final product, a mathematical model based on integrating data and expert judgements, advances highway construction project post-evaluation standardization and objectivity. Combining many criteria into a logical, quantitative framework simplifies assessment and gives a complete lens for project evaluation. This model measures project performance and illustrates the complicated link between defined criteria and project results using multiple regression analysis. The equation, based on statistical accuracy and expert insights, predicts highway project success.

The proposed approach may enhance the construction's post-evaluation vision. It gives stakeholders and decision-makers a systematic, unbiased, and comprehensive tool to assess project performance. This research also emphasizes the need for post-project evaluations for organizational learning, risk reduction, and innovation.

This research helps find a standard, adaptable framework for post-evaluating highway construction projects. It shows how empirical knowledge and quantitative precision work together to evaluate and guide highway construction projects.

This research extensively defined and revised post-evaluation criteria. Efficiency, which covers cost, time, and quality; traffic analysis, which evaluates volume, travel time, and effect; safety, which includes accidents and security; sustainability, which includes economic and social impacts, guided the review procedure.

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التقييم اللاحق العالمي لمشاريع انشاء الطرق السريعة

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الخلاصة

ويعد التقييم اللاحق للمشاريع في مجال تشييد الطرق السريعة أمرا بالغ الأهمية ولكنه متخلف في إدارة البنى التحتية، ولا سيما بالنسبة لسلطات مشاريع الطرق العراقية. وتضم هذه الدراسة الشاملة أفكاراً مستقاة من مخططات عالمية في إنكلترا واسكتلندا وفرنسا وأستراليا والنرويج ونيوزيلندا لوضع إطار قوي للتقييم اللاحق. واستخدمت هذه الدراسة معايير مستمدة من ستة مخططات دولية، ومن خلال إطار تحليل مواضيعي ومقابلات مفتوحة مع خبراء لتحديد وتحسين القائمة النهائية للمعايير التي يمكن استخدامها في عملية التقييم، حيث تم تحديد خمسة معايير كنتيجة نهائية، وهي الكفاءة (التكلفة والوقت والجودة)، وتحليل حركة المرور (الحجم، ووقت السفر، والأثر)، والسلامة (الحوادث والأمن)، والاستدامة، والأثر(الاقتصادية والاجتماعية). و يتم وزن المعايير، باستخدام تقنية (IPV)، من أجل إيجاد نموذج انحدار متعدد لنجاح المشروع. وتشدد هذه الدراسة على الحاجة إلى إطار شامل للتقييم اللاحق ، لا سيما في مجال تشييد الطرق السريعة المعقدة. يتم الوصول إلى علامة فارقة عندما يتم الجمع بين المعايير الدولية واستخراج المتغيرات الدقيقة. ويبسّط النموذج الرياضي، الذي يستند إلى البيانات التجريبية وحكم الخبراء، التقييم ويتنبأ بنجاح المشروع، مما يتيح لأصحاب المصلحة أداة تقييم منهجية وشاملة.

الكلمات المفتاحية: الطريق السريع، التقييم اللاحق ، التقييم ، النموذج الرياضي, ادارة المشاريع.