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USING THE DELPHI TECHNIQUE AND EFQM MODEL APPROACH TO BUILD A CONCEPTUAL MODEL FOR CONSTRUCTION PROJECT PERFORMANCE

ABSTRACT

This study presents a new conceptual framework for evaluating the performance of construction projects, based on an adaptation of the European Foundation for Quality Management (EFQM) model. Although the EFQM model is widely used for quality management and performance evaluation, there have been few studies to date that have used it to measure the performance of projects, which is a very important issue in the construction industry. The EFQM model is designed for organisations, so if it is to be used for construction projects, appropriate modifications are needed. That is, the criteria and attributes of the original EFQM model need to be modified. Therefore, the aim of the study is to develop a new set of criteria and their attributes. The attributes are drawn from previous studies and adapted to construction projects. The set of criteria and their attributes form a conceptual model for measuring construction project performance. The model was validated through semi-structured interviews with 20 experts. The results of the study showed that the conceptual model had five enabler criteria, two result criteria, and 50 criteria attributes. The qualitative and quantitative analysis results of the Delphi technique confirmed the importance of these criteria and their reliability. The results of the study will contribute to promoting the application of the EFQM model in the field of construction project management. In addition, stakeholders can use the model as a tool to evaluate the performance of construction projects.

Keywords: conceptual model, performance measurement, project performance, construction project, EFQM

JEL Classification: M19, N60, O22

INTRODUCTION

The construction sector has a major influence on the local and worldwide economies and is essential to socioeconomic growth (Arashpour et al. 2014; Arditi and Mochtar 2000; Hasan et al. 2018). Al Alyani and Lee (2024) state that construction project performance measurement (CPPM) is a complex undertaking with the goal of comprehending and enhancing project outcomes. Historically, time, quality, and financial criteria have been the mainstays of CPPM. The sector has undergone a revolution with the advent of non-financial measurements, which offer a comprehensive and holistic perspective on project success (Neely 1999). With the use of the European Foundation for Quality Management (EFQM) approach, this study seeks to close current gaps and improve the theoretical and practical elements of CPPM by creating a conceptual model for it.

CPPM research has progressed tremendously over time. Several models have been devised and implemented, each with unique strengths and limitations. The EFQM methodology excels at achieving organisational excellence by combining several performance criteria (Escrig and De Menezes 2015; Para-González, Jiménez-Jiménez, and Martínez-Lorente 2022). The EFQM model, which was originally created for general organisational operations, needs to be adjusted to meet the special needs and complexity levels of building projects. Recent research (Al-Tabbaa, Gadd, and Ankrah 2013; Liu and Ko

2018) show that the approach may be used for continuous improvement and strategy alignment in diverse contexts, including non-profit organisations and the hospitality industry.

Despite tremendous progress, there are still significant gaps in the current literature on performance measurement in construction. Existing models frequently fail to capture all of the variables that determine project performance, particularly non-financial data. Furthermore, there is no agreement on the best criteria and performance indicators for construction project performance measurement (CPPM) (Bassioni, Price, and Hassan 2004; Beatham et al. 2004). The study intends to solve these gaps by creating a well-defined conceptual model for building projects based on the EFQM framework. Through rigorous examination of existing models and expert surveys, the research has modified the criteria and attributes of the EFQM model to better reflect the unique challenges and requirements of the construction industry.

The results of the research will narrow the gap between theory and practice in the field of construction project performance management (CPPM). The developed model will provide a solid theoretical foundation for CPPM, making a significant contribution to academic discourse. Educators can utilise this model to train future project managers, equipping them with effective tools to manage and evaluate complex construction projects. For stakeholders such as policymakers, investors, and contractors, this model serves as a tool to manage project performance, facilitating better decision-making and strategic planning (Cannas and Gosling 2021). The anticipated contributions to theory and practice will shape future research and enhance the management of construction projects, leading to more successful and sustainable outcomes.

LITERATURE REVIEW

Measuring project performance in construction is an important issue in both research and industry practice to enhance project outcomes and stakeholder satisfaction. This literature review synthesises significant studies contributing to the understanding of project performance measurement frameworks, with a particular emphasis on the EFQM Excellence Model and its applications in the construction sector.

Performance measurement is a complex field in the construction industry. Numerous studies have proposed new requirements in this area. Al Alyani and Lee (2024) emphasise the need to align organisational objectives with project outcomes in the context of regulatory pressures. Bassioni et al. (2004, 2005) propose a framework to adjust relevant metrics to strategic goals, highlighting appropriate indicators for different construction phases. Beatham et al. (2004) argue that key performance indicators (KPIs) play a crucial role in project measurement. Additionally, there is a need to integrate new requirements such as sustainability and innovation to address global objectives (Giménez Espín, Jiménez Jiménez, and Martínez Costa 2023); blockchain contracts; and enhanced transparency (Cheng, Chong, and Xu 2023). Therefore, future research should refine frameworks, explore technologies, and engage stakeholders to establish a robust operational system. The EFQM model can align strategies with outcomes, integrating quality, sustainability, and innovation to optimise performance and stakeholder satisfaction. Thus, the EFQM model can address the new requirements in project performance management.

The EFQM model was born in 1989. This study searches for CPPM documents related to the EFQM model in the past decades. The search results show that the application of the EFQM model in the CPPM field has developed. That development can be divided into 3 phases as follows:

Phase one: From 1989 to the mid-2000s. This stage has had studies that laid the foundation for project performance measurement. The main research directions can be mentioned as follows:

1. Research direction on the necessity of building a new performance measurement system. This research direction marks the beginning of a performance measurement revolution in the field of production management. A typical example is the study of Neely (1999).
2. The research direction focuses on building models to measure performance in construction. This research direction emphasises the need for appropriate approaches. A typical example is the study by Bassioni et al. (2004).
3. The research focuses on the development and characteristics of the EFQM model. This research mainly emphasises the advantages of the EFQM model. At the same time, it points out the approaches to the EFQM model for different fields. A typical example is the study by Eskildsen et al. (2001).

Phase two: From the mid-2000s to 2010. This phase has recorded a number of studies applying the EFQM model in the field of construction management. Two typical research directions in this phase can be mentioned as follows.

Research direction applying the EFQM model to measure a certain index in construction management. There are two typical studies following this direction:

1. First, Castka et al. (2003) modified the EFQM model to measure team culture and at the same time demonstrated the flexibility of the model. Sometime later, Bassioni et al. (2005) built a conceptual framework for measuring business performance in construction. The study showed that excellent models need to be adjusted to suit the characteristics of the construction industry.
2. Research direction analysing the suitability of the criteria in the EFQM model. Beatham et al. (2004) assessed the use of key performance indicators (KPIs) in construction as inadequate and emphasised the need to find other performance indicators that are suitable for the specific needs of the construction industry. That is, it is necessary to modify the criteria and attributes in the model.

Phase 3: From 2010 to present. This phase has seen studies using EFQM for different subjects in the construction industry. The three main research directions are as follows:

1. The first research direction is to integrate the principles of the EFQM model with another method. For example, the combination of EFQM and system dynamics in the study of Soewin & Chinda (2020).
2. The second research direction is to use EFQM to measure different subjects in the construction industry. The study of Alkilani & Loosemore (2022) can be mentioned. The author applied EFQM to small and medium-sized contractors.
3. The third research direction is to link EFQM to emerging topics. These research directions have adjusted the EFQM model to suit those topics. Some emerging topics that are incorporated into the EFQM model by studies include sustainability (Cheng et al., 2023) and digital transformation (Morgado Oliveira & F. Gomes, 2024).

The EFQM model has the ability to provide a structured yet flexible framework. Modified EFQM models all emphasise a comprehensive approach, considering leadership, strategy, people, partnerships, resources, processes, and results (Bocoya-Maline, Rey-Moreno, and Calvo-Mora 2024). This model is suitable for the complex nature of construction project management. The EFQM model emphasises a holistic approach, integrating multiple aspects of different organisational functions and promoting a comprehensive understanding of project performance (Al-Tabbaa et al. 2013; Bocoya-Maline et al. 2024). Unlike traditional frameworks that may focus narrowly on specific metrics or quality management principles, EFQM incorporates broader organisational factors such as leadership capability, strategy, people, partner relationships, resources, and processes (Bou-Llusar et al. 2009). This perspective encourages organisations to assess operational effectiveness, strategic alignment, and stakeholder engagement, fostering sustainable improvement throughout the project lifecycle (Bassioni et al. 2004).

Furthermore, according to Bou-Llusar et al (2009), EFQM offers a wider scope by combining elements of innovation and social effects. According to (Escrig and De Menezes 2015), the model's structured self-assessment approach and adaptability to various organisational contexts make it a strong foundation for promoting continuous improvement and long-term success in building projects. The structured evaluation criteria and rigorous assessment process of EFQM offer clear guidance for enhancing performance, ensuring learning, and continuously adapting to dynamic project environments.

While most studies utilise the original EFQM model, some studies modify it by adjusting criteria, relevant attributes, or criteria weights. Depending on the study, the EFQM model can be altered in one, two, or all three ways. When modifying the criteria of the original EFQM model, some studies have added or removed certain criteria to better fit their specific context. The Project Management Performance Assessment (PMPA) model developed by Bryde (2003), the Non-Professional Project Management Performance Assessment (NPPMPA) model developed by Lannon and Anderson (2019), the Project Excellence model developed by Westerveld (2003), the PMPA model developed by Qureshi et al. (2009), the Safety Culture model developed by (Chinda and Mohamed 2007), and the effective TEAM model developed by Castka, Bamber, and Sharp (2003) are a few notable examples.

Going deep into the construction of a project management performance evaluation model, prominently the model by (Bryde 2003), the author asserts that the EFQM model is often used as a framework to assess the progress of an organisation and is also highly feasible when used to evaluate the effectiveness of project management. However, there are still limitations. The author presents two reasons for modifying the model. Firstly, project management units differ from project implementation units. Secondly, modifying the model is also a way to contribute to the theoretical development of the project management field. The modified model is the Project Management Performance Assessment (PMPA) model with six criteria (Bryde 2003). The outcome criteria are grouped into two criteria in Figure 1.

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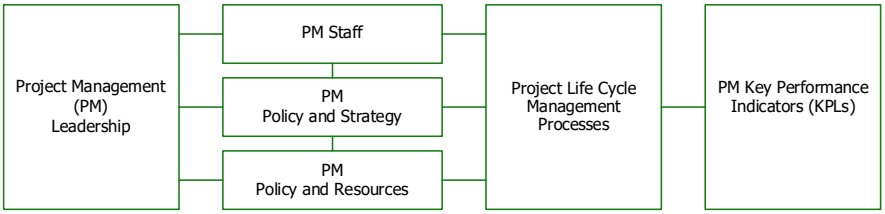

Figure 1. The PMPA Model. *(Source: adapted from Bryde, 2003)*

Like (Bryde 2003), Chinda and Mohamed (2007) modified the EFQM model into the Construction Safety Culture Model with six criteria. Their research primarily focused on improving the criteria of the coordinator to achieve better results, regardless of which of the four results of the EFQM model affected the improvements. Therefore, they merged the four "results" criteria into a single "objective" structure. In contrast to these modifications, Westerveld (2003) developed the Excellent Project Model from the perspective that the success factors of a project should be considered as support areas, while the success criteria of the project should be seen as result areas. This approach creates a model with 10 criteria, divided into 5 support criteria and 5 result criteria, while including narrowly defined criteria (Westerveld 2003). Based on Bryde's (2003) PMPA model, Lannon and Anderson (2019) constructed the proposed Non-Profit Project Management Performance Assessment (NPPMPA) model. This study has three criteria in the result area: key performance indicators of customers and society; key performance indicators of staff and volunteers; and key performance indicators (KPIs) of sponsors, partners, and organizations. Some other studies modify the EFQM model in a second way by adjusting the weights of the criteria. This means that the criterion scores have changed. The authors analysed in detail the complex nature of the scores in the EFQM model (Escrig and De Menezes 2015). Based on that analysis, the criterion scores when applying this model are calculated to assess the operational efficiency in the hotel industry (Liu and Ko 2018). However, through the search, there are very few studies that modify the scores of the EFQM model.

The research conducted by Westerveld (2003) suggests that the project outcome domain is the main criterion for project success. These success criteria can be classified into two groups, as identified by Beatham et al. (2004) and Silva et al. (2016). Beatham et al. (2004) examined and evaluated the literature on Key Performance Indicators (KPIs), concluding that outcome criteria fall into two main categories: primary performance outcomes and perception measures. Similarly, (Silva et al. 2016) propose that project success criteria can be divided into two groups, as shown in Figure 2.

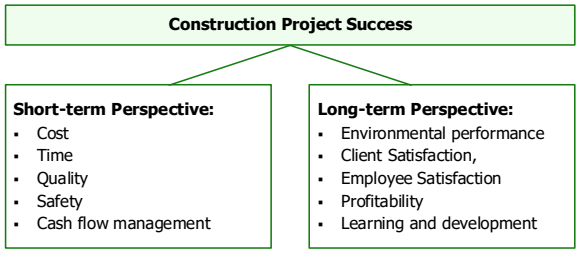

Figure 2. The Framework for Construction Project Success. *(Source: Silva et al. 2016)*

Based on the synthesis of previous literature, a list of five modified EFQM models that can be used for this research is summarised in Table 1.

Table 1. Five modified EFQM models are used.

List	Model	Author
1	The TEAM Model	(Castka, Bamber, and Sharp 2003)
2	The PMPA Model	(Bryde 2003)
3	The CSC Model	(Chinda and Mohamed 2007)
4	The NPPMPA Model	(Lannon and Anderson 2019)
5	The Framework for Construction Project Success	(Silva et al. 2016)

Table 1 outlines five possible models considered in this research, with the objective of developing a new model inspired by the EFQM framework to assess project implementation effectiveness. Following a detailed analysis, the study determined that the framework by Silva et al (2016) is particularly suitable and adaptable to Vietnam's context. Consequently, the proposed

model divides the project's success criteria into two categories: short-term and long-term objectives. This distinction is intended to highlight the significance of long-term performance, which is crucial for sustainability in project management. The new model retains the five enabler elements from the original EFQM framework but modifies the results criteria by categorizing them into long-term and short-term project outcomes. The method for scoring the enabler criteria remains unchanged, with a total of 500 points allocated to the results section, evenly split between the two performance criteria. This balanced approach enables a comprehensive evaluation of both the immediate and future impacts of a project, enhancing the model's relevance and effectiveness in construction project management.

AIMS AND OBJECTIVES

The purpose of this study is to develop a conceptual model for construction projects in Vietnam. This model is developed by adjusting the original EFQM model. The new model will have characteristics that are suitable for the characteristics of the construction industry. It will help stakeholders evaluate the effectiveness of the project accurately.

To achieve this objective, the study performs the following tasks:

1. *Review of documents:* The study analyses previous documents on the application of the EFQM model in different fields, thereby drawing out ways to adjust this model to suit the construction industry in Vietnam.
2. *Develop criteria and search for attributes:* Based on the analysis results, the study establishes criteria in the model. These criteria include leadership, people, policies, and strategies. Partnerships and resources, processes, short-term project performance, and long-term project performance. In addition, the study also builds a system of attributes for these criteria.
3. *Model Validation:* The proposed model was tested and validated through feedback from industry experts. The study used the Delphi method to ensure practicality and accuracy.

METHODS

The research framework is implemented in the sequence shown in Figure 3.

First, the research will search for relevant documents on the EFQM model and documents related to measuring performance in construction projects. A list of different models (based on the EFQM model) will be identified and become an important part of this research. Additionally, systematically reviewing the literature will help identify gaps in previous studies.

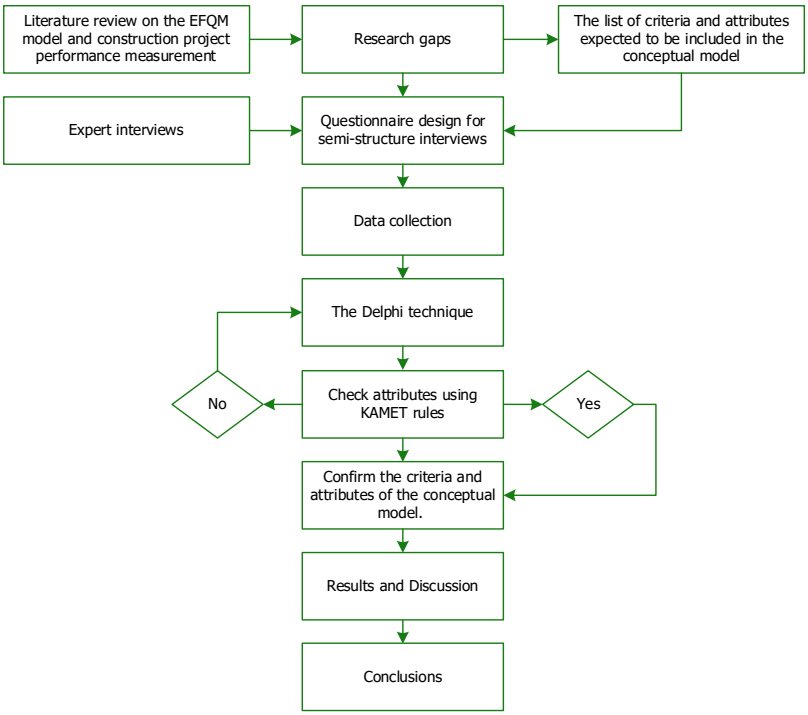

Figure 3. Research framework and methodology.

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Second, the research proposes a basic model with different criteria based on the findings from the initial phase and expert advice. Building on this basic model, the research will further explore the attributes of the criteria in the model. These attributes and criteria can be kept as they are or modified to fit the research context.

Third, not all attributes of the criteria in the basic model may be applicable to the research. Confirming or eliminating these attributes is necessary. Therefore, the research will use the Delphi expert interview method (Dalkey & Helmer, 1963) to confirm or eliminate certain attributes of the criteria. This method is considered an important approach to seeking consensus among experts (Pamidimukkala and Kermanshachi 2022).

After using the Delphi method and the Kamet rule, the final model for construction project performance with criteria and attributes will be confirmed. Finally, the research will discuss the findings and limitations to identify future research directions.

RESULTS

Results of editing the proposed model according to expert opinions

Based on the model construction methods of five studies in Table 1, the study modified the original EFQM model into a new model for measuring the performance of construction projects. The perspective of Silva et al. (2016) was applied to divide the project outcome criteria into short-term and long-term outcomes. Therefore, the proposed model will have seven criteria. The five enabler criteria include leadership (LD), people (PE), policy and strategy (PO), partnership and resources (PA), and processes (PR). The two result criteria include short-term project performance (SH) and long-term project performance (LO). The interviewed individuals have provided feedback on the names of the criteria and the descriptions of the criteria as follows:

Leadership: The criterion describes how leaders will achieve project effectiveness. The elements of this criterion must include essential leadership skills, the leader's commitments to the project and stakeholders, and how leaders handle project-related situations. Leaders are also responsible for providing direction, guidance, and inspiration to the workforce.

People: The criterion describes how a project utilises and develops the capabilities of the workforce. The unique characteristics of individuals in the workforce will impact the effectiveness of project implementation. Projects always value the individual's worth and create an environment for their development. There is always a relationship between the interests of the workforce and project effectiveness. Projects also encourage creativity and potential and provide appropriate rewards and benefits.

Policies and strategies: The criterion describe the policies and strategies of a project. Policies are developed and implemented throughout the project to ensure the execution of strategies. Policies are primarily expressed through the management system and project plans.

Partnerships and resources: Partnerships and resources are two important components in project implementation. Projects always involve collaboration with multiple stakeholders. The management and utilisation of relationships with stakeholders strongly influence the effectiveness of project implementation. In addition, the exploitation of resources and assets also affects plans and strategies, thereby impacting the effectiveness of project implementation.

Processes: The criterion encompasses all the processes carried out in the project. Projects use processes to control the activities of individuals and stakeholders involved in the project. Projects build and continuously improve processes to enhance the effectiveness of project implementation.

Short-term project performance: The criterion explains that the effectiveness of project implementation must be a goal of the project. This criterion is the first criterion out of two result criteria. It describes all the outcomes that the project achieves immediately after the project ends. These outcomes can be easily quantified accurately and are often used to evaluate the success of a project. These outcomes contribute significantly to assessing the effectiveness of project implementation.

Long-term project performance: The criterion is the second criterion out of two outcome criteria. This criterion describes the future achievable impacts of the project. The impacts that the project achieves after completion can have long-term effects on both the project itself and the implementing organization. The construction project performance (CPP) model ensures that the project is measured not only by short-term outcome objectives but also by long-term outcome objectives. The long-term outcome objectives include all the remaining objectives of the project. It also contributes significantly to evaluating the effectiveness of project implementation.

The study conducted structured interviews with 20 construction management experts, including 15 experts with master's degrees and 5 experts with doctoral degrees, all with over 10 years of experience and involvement in at least three projects. Feedback was collected based on the criteria of the proposed model, allowing experts to add, delete, or modify them. Statis-

tical analysis of the interview results confirmed the suitability of the CPP model with seven criteria. Additionally, the interviewees agreed that the five supporting criteria in the CPP model should maintain the same scores as the original model. In Vietnam, awareness of project success has developed, so short-term and long-term project objectives must be equally important. Therefore, the experts proposed that the scores for both outcome criteria be set at 250. The result is the CPP model with seven criteria and adjusted scores for each criterion, as shown in Figure 4.

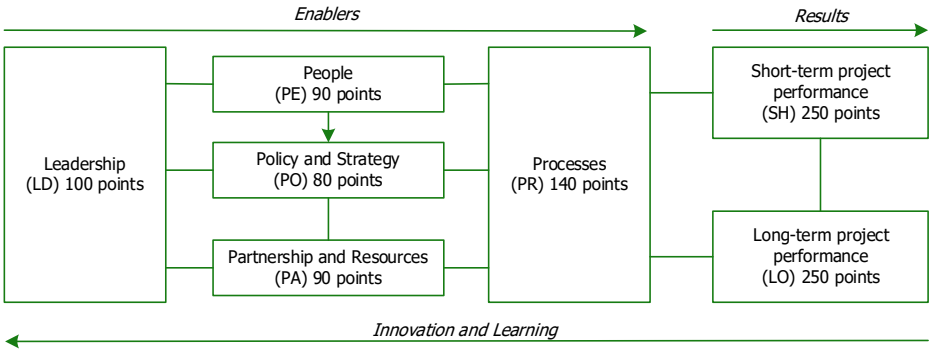

Figure 4. The conceptual model of construction project performance (CPP).

Quantitative analysis results

Experts were asked to assess the importance of criteria in the CPP model through semi-structured interviews. A 5-point Likert scale was used, with options ranging from not important (1) to extremely important (5). The interviews evaluated the importance, description, usefulness, practicality, and applicability of the criteria in the CPP model, allowing experts to propose improvements. The study collected 20 complete responses from experts, which were then quantitatively analyzed. With a small sample size, the Kolmogorov-Smirnov test was used to verify a normal distribution, as suggested by (Razali and Wah 2011) and (Bassioni et al. 2005). The results are shown in Table 2.

Table 2. Kolmogorov-Smirnova Tests.

Tests of Normality				
	Kolmogorov-Smirnova		Descriptive Statistics	
	Statistic	Sig.	Mean	Std. Deviation
LD	0.22422363	0.05469	4.14	0.770
PE	0.22588377	0.05112	3.93	0.829
PO	0.22588377	0.05112	4.07	0.829
PA	0.22422363	0.05469	3.86	0.770
PR	0.21428571	0.08085	4.00	0.784
SH	0.21428571	0.08085	4.00	0.784
LO	0.22422363	0.05469	4.14	0.770

The results in Table 2 show that the p-value coefficients for all criteria are greater than 0.05. This indicates that all interview responses meet the requirements. The mean coefficient indicates a high level of consensus in the answers, and all responses agree that the criteria in the model are important.

List of criteria and related attributes

The relevant attributes for each criterion were synthesised from previous studies. These attributes were compiled into a table and sent to experts for evaluation and modification. Some attributes were adjusted and rephrased to align with the focus and research context of Vietnam. Based on expert interview opinions, the study eliminated attributes deemed unnecessary or inappropriate. Finally, the study identified 50 attributes of the criteria in the conceptual model. The attributes are labelled and listed as follows:

Leadership:

- LD1: Planning and goal setting for the project (Zakaria et al. 2015);
- LD2: Communication skills (Awan, Ahmed, and Zulqarnain 2015);
- LD3: Problem-solving and decision-making skills (Zakaria et al. 2015);
- LD4: Conflict resolution (Awan et al. 2015);

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- LD5: Team building and delegation skills (Ekung and Ujene 2014);
- LD6: Leadership's commitment to the project (Omran, Abdalrahman, and Pakir 2012);
- LD7: Leadership styles for each situation (Liphadzi, Aigbavboa, and Thwala 2015);
- LD8: Listen actively and respect team members' opinions (Podgórska and Pichlak 2019).

People:

- PE9: Qualifications and work experience (Soewin and Chinda 2018);
- PE10: Work attitudes and work motivation (Omran et al. 2012);
- PE11: Relationships between employees (Omran et al. 2012);
- PE12: Ability to absorb knowledge (Juliet and Ruth 2014);
- PE13: Teamwork skills (El-Rahman et al. 2015);
- PE14: Employee satisfaction (Silva et al. 2016).

Policy and Strategy:

- PO15: Designing a quality management system (Enshassi, Mohamed, and Abushaban 2009);
- PO16: Investment in research and development (Fagbenle, Ogunde, and Owolabi 2011);
- PO17: Training project-required skills in human resources (Juliet and Ruth 2014);
- PO18: Building a safety program (Omran et al. 2012);
- PO19: Planning for Construction Projects (Jega and Jimoh 2022);
- PO20: Building recruitment and employee development plans (Enshassi et al. 2009).

Partnership and Resources:

- PA21: Financial planning and control (Bassioni et al. 2005);
- PA22: Disputes between the parties in the construction project (Juliet and Ruth 2014);
- PA23: Communication between construction project parties (Enshassi et al. 2009);
- PA24: Quality of equipment and materials (Jega and Jimoh 2022);
- PA25: Quality of construction design (Jega and Jimoh 2022);
- PA26: Plan to cooperate with suppliers (Abbasbhai and Patel 2020).

Processes:

- PR27: Processes are communicated to staff and stakeholders (Bassioni et al. 2005);
- PR28: Cost control process in construction projects (Enshassi et al. 2009);
- PR29: Information feedback process (Abbasbhai and Patel 2020);
- PR30: Quality control of materials and equipment (Omran et al. 2012);
- PR31: Quality assurance in a construction project (Juliet and Ruth 2014);
- PR32: Troubleshooting process in construction projects (Enshassi et al. 2009).

Short-term project performance:

- SH33: Number of works that must be repaired or remarked (Enshassi et al. 2009);
- SH34: Types of construction project costs (Ingle and Mahesh 2022);
- SH35: Construction project completion times (Silva et al. 2016);
- SH36: Labor productivity in construction projects (Enshassi et al. 2009);
- SH37: Construction product quality (Yao, Du, and Hu 2012);
- SH38: Construction product and service prices (Juliet and Ruth 2014);
- SH39: Health and safety in construction projects (Juliet and Ruth 2014);
- SH40: Number of occupational accidents (Ingle and Mahesh 2022);
- SH41: Number of disputes between the parties in construction projects (Juliet and Ruth 2014).

Long-term project performance:

- LO42: Environmental impacts of construction projects (Juliet and Ruth 2014);
- LO43: Revenue from relative business (Yao et al. 2012);

- LO44: Appreciation by project personnel (Silva et al. 2016);
- LO45: Customer satisfaction (Westerveld 2003);
- LO46: Appreciation by stakeholders (Silva et al. 2016);
- LO47: Appreciation by partners (Westerveld 2003);
- LO48: Impacts on society (Enshassi et al. 2009);
- LO49: Learn from failures and incidents (Enshassi et al. 2009);
- LO50: People's feedback around the construction project (Enshassi et al. 2009).

The attributes are validated using the Delphi method and the Kamet rules

The interview questionnaire for experts is designed with a Likert scale of 5 levels, as mentioned above. After obtaining the answers, the study calculates three values: Mqi (the mean of the ratings for questionnaire item qi), Qqi (the quartile range), and Vqi (the ratio of experts who changed their rating for qi). The Kamet rule is used to confirm the attributes. The Kamet rule is as follows:

1. If Mqi ≥ 3.5, Qqi ≤ 0.5, and Vqi<15%, then qi is accepted, and no further discussion concerning qi is needed.
2. If Mqi < 3.5, Qqi ≤ 0.5, and Vqi ≤ 15%, then qi is disqualified, and no further discussion concerning qi is needed.
3. If Mqi≥3.5 and Qqi > 0.5 or Vqi>15%, then perform another round.

The results of Delphi Round 1 indicate that the average values of the attributes are all greater than 3.5. This demonstrates a high level of consensus among the 20 experts. The results also show that there are 39 attributes that satisfy the conditions Mqi≥3.5 and Qqi≤0.5. There are 11 attributes that have Mqi≥3.5 and Qqi>0.5. Therefore, it is necessary to proceed with Delphi Round 2. The study conducted Delphi Round 2 with the initial 20 experts, and some experts changed their opinions. However, the results of Delphi Round 2 indicate that all 11 remaining attributes still satisfy the conditions Mqi≥3.5, Qqi≤0.5, and Vqi≤15%. Finally, all 50 attributes received a high level of consensus from the experts through the Delphi method and the Kamet rules. The results are presented in Table 3.

Table 3. The analysis results using the Delphi technique and Kamet rule.

Label	Round Delphi-1 20 experts			Round Delphi-2 20 experts			Label	Round Delphi-1 20 experts			Round Delphi-2 20 experts		
	Mean	Q	V	Mean	Q	V		Mean	Q	V	Mean	Q	V
LD1	4.000	0.750	0%	3.900	0.375	10%	PA26	4.200	0.500	0%			
LD2	4.100	0.375	0%				PR27	4.250	0.500	0%			
LD3	4.050	0.000	0%				PR28	3.700	0.500	0%			
LD4	4.000	0.000	0%				PR29	3.650	0.375	0%			
LD5	3.950	0.000	0%				PR30	4.300	0.500	0%			
LD6	3.900	0.375	0%				PR31	4.300	0.500	0%			
LD7	4.000	0.000	0%				PR32	3.750	0.875	0%	4.000	0.500	10%
LD8	4.300	0.500	0%				SH33	3.650	0.375	0%			
PE9	3.750	0.875	0%	4.050	0.500	10%	SH34	3.650	0.375	0%			
PE10	3.800	1.000	0%	4.050	0.500	5%	SH35	3.850	0.875	0%	3.950	0.500	10%
PE11	3.700	0.500	0%				SH36	3.950	0.000	0%			
PE12	4.250	0.375	0%				SH37	3.800	1.000	0%	4.000	0.500	10%
PE13	4.250	0.375	0%				SH38	3.650	0.375	0%			
PE14	4.050	0.000	0%				SH39	4.100	0.375	0%			
PO15	3.600	0.500	0%				SH40	3.700	0.875	0%			
PO16	3.650	0.375	0%				SH41	3.650	0.375	0%			
PO17	3.500	0.500	0%				LO42	4.050	1.000	0%	4.400	0.500	15%
PO18	3.700	0.500	0%				LO43	4.000	0.000	0%			
PO19	4.100	0.500	0%				LO44	3.750	0.875	0%	4.000	0.500	10%
PO20	4.150	0.500	0%				LO45	4.000	0.000	0%			
PA21	3.500	0.500	0%				LO46	3.950	0.000	0%			
PA22	3.900	0.375	0%				LO47	4.250	0.375	0%			
PA23	3.850	0.000	0%				LO48	3.850	1.000	0%	4.150	0.500	10%
PA24	4.250	0.375	0%				LO49	3.950	0.000	0%			
PA25	3.750	0.875	0%	4.050	0.500	10%	LO50	4.000	0.000	0%			

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DISCUSSION

The research results confirmed that the EFQM model can be effectively applied to construction projects, however, some adjustments need to be made to suit the specific characteristics of this industry. This was clearly demonstrated by the high level of consensus from the interviewees, indicating a consensus on the feasibility and effectiveness of applying this model. On a global scale, excellent project models have also been developed through the adjustment and refinement of the original EFQM model, which further confirms the flexibility and wide applicability of EFQM in different contexts, especially in the construction sector.

Based on the EFQM model, the study has built a CPP model with 7 criteria instead of 5 criteria as the original model. There are only two outcome criteria: short-term performance outcome criteria and long-term performance outcome criteria. The EFQM model's results area has 4 criteria, while the CPP model's results area has only 2 criteria. This division is simpler and can help stakeholders control project results more easily than the original model.

The investigation also found 50 attributes out of 7 criteria. These characteristics are the outcome of earlier documents' search and filtering procedures. Compared to the original EFQM model, which had 32 attributes, the CPP model has 50 attributes. This suggests that there is a basic distinction when using the EFQM approach for building projects in developing countries like Vietnam. The performance of building projects is thought to be influenced by a number of intricate aspects. As a result, there are more and a wider variety of attributes that are used to gauge its performance.

The foundation of the CPP model is the idea that better short- and long-term project performance may be achieved by improving five enabler criteria: partnerships, people, policies and strategies, processes, and leadership (Bocoya-Maline et al. 2024; Bou-Llusar et al. 2009; Calvo-Mora, Navarro-García, and Periañez-Cristobal 2015). Long-term project performance addresses sustainability consequences like stakeholder satisfaction and environmental impact, whereas short-term goals concentrate on immediate results like cost control and quality. With its full framework for enhancing sustainability performance in building projects, the CPP model is both practically possible and academically valid.

CONCLUSIONS

The study has developed an innovative model called CPP by adapting the EFQM model. Drawing on profound insights from established theories and frameworks in construction management, the CPP model has been created to measure the performance of construction projects. The final CPP model consists of seven criteria (five enabler criteria and two result criteria) that allow for a comprehensive evaluation of project performance, encompassing both short and long-term performance.

Confirming the model requires extensive interaction with 20 experienced construction management experts in Vietnam through semi-structured interviews. Their unanimous agreement on the emphasised criteria highlights the robustness and practicality of the model. Furthermore, quantitative analysis has confirmed the significance of each criterion in the model. The results of the Delphi method and Kamet's rule demonstrated the consensus of the expert panel on the attributes of the model. In addition, the Kolmogorov-Smirnov test has validated the reliability and normal distribution of expert opinions, thus reinforcing the model's credibility. The research was conducted in Vietnam, a developing country; therefore, it has the potential for application in other developing countries.

Research contributes significantly to construction management by bridging the gap between the theoretical framework of the EFQM model and its practical application. It provides a theoretical foundation for implementing the EFQM model in the construction industry. Additionally, the CPP model serves as a practical tool for stakeholders to measure project performance in construction. This facilitates informed decision-making and enhances project performance across different construction contexts.

The study introduces a comprehensive framework for evaluating the performance of construction projects. Improving the EFQM model and integrating modern perspectives will enhance measurement methods and improve performance in construction projects. Applying this model promises to reshape project evaluation activities, emphasising overall results and sustainable impact worldwide. This research marks a significant step in enhancing project management practices, fostering innovation, and achieving excellence in construction project implementation.

Although research also acknowledges limitations such as the sample size of experts, Future research should focus on validating the model across different project environments and global legal frameworks.

ADDITIONAL INFORMATION

AUTHOR CONTRIBUTIONS

All authors have contributed equally.

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CONFLICT OF INTEREST

The Authors declare that there is no conflict of interest.

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ВИКОРИСТАННЯ МЕТОДУ ДЕЛЬФІ ТА МОДЕЛЬНОГО ПІДХОДУ EFQM ДЛЯ ПОБУДОВИ КОНЦЕПТУАЛЬНОЇ МОДЕЛІ ВИКОНАННЯ БУДІВЕЛЬНОГО ПРОЄКТУ

Дослідження представляє нову концептуальну основу для вимірювання ефективності будівельних проєктів шляхом адаптації моделі Європейського фонду управління якістю (EFQM). Незважаючи на те, що модель EFQM широко використовують, існує обмежена кількість досліджень, які застосовують її для вимірювання ефективності будівельних проєктів. На сьогодні вимірювання ефективності проєкту стало важливим питанням. Тому метою дослідження є розробка нової моделі вимірювання для будівельних проєктів шляхом коригування моделі EFQM. Модель перевірена за допомогою напівструктурованих інтерв'ю з 20 експертами. Модель складається з п'яти критеріїв сприяння, двох критеріїв результату й 50 атрибутів критеріїв. Якісний і кількісний аналіз методу Дельфі підтвердив важливість цих критеріїв і їхню достовірність. Результати дослідження сприяють застосуванню моделі EFQM у будівельній галузі, одночасно надаючи зацікавленим сторонам інструмент для оцінки ефективності будівельних проєктів.

Ключові слова: концептуальна модель, вимірювання ефективності, виконання проєкту, будівельний проєкт, EFQM

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