RESEARCH ON PROPOSING AN EFFECTIVENESS ASSESSMENT CRITERIA FRAMEWORK OF RESIDENTIAL AND COMMERCIAL BUILDING CONSTRUCTION INVESTMENT PROJECTS TOWARD SUSTAINABLE DEVELOPMENT IN NHA TRANG CITY

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Abstract - In the context of global climate change, sustainable development has become a critical factor in housing and commercial construction projects. This research aims to propose a framework of criteria for evaluating the effectiveness of construction investment projects aligned with sustainable development goals. The proposed framework is divided into five key groups: time and cost efficiency, quality and safety performance, environmental protection, social accessibility and affordability, and satisfaction and legal compliance. A total of 21 criteria have been identified for empirical surveys. The study will collect and analyze data, assess the level of consensus, and rank the criteria accordingly. The research outcomes will provide a framework to assist regulatory agencies and investors in evaluating and selecting projects with sustainable development potential, thereby contributing to the long-term and comprehensive development of the city.

Key words - Sustainable development; Assessment criteria framework; Residential and Commercial building; Investment and construction projects; Nha Trang city

1. Introduction

In the context of climate change, sustainable development becomes an important factor, especially in housing and commercial service construction projects, to reduce the impact on the environment and the community. To optimize the use of water, energy and land resources, it is necessary to develop a framework of criteria for effective assessment and management.

In Nha Trang, the People's Committee of Khanh Hoa province has approved the green transformation project 2024-2030 to build a sustainable, modern and environmentally friendly urban area. Resolution 09-NQ/TW also sets the goal of developing Khanh Hoa province into a centrally-governed city by 2030, with Nha Trang as the core urban area.

This study focuses on identifying and developing a comprehensive criteria framework to effectively assess investment projects in housing and commercial service construction in Nha Trang, integrating sustainable development factors. At the same time, the study also provides specific recommendations and instructions for applying the criteria framework into the practice of managing construction investment projects.

2. Research overview

The criteria framework in this study aims to evaluate the success of housing and commercial service construction projects towards sustainable development, applied at the time of completion and successful projects. Projects in the preparation phase can refer to this framework to improve the likelihood of success. Consulting experts can also use the criteria framework to make investment decisions for sustainable development in Nha Trang. The benefits of the standard set are shown in Figure 1.

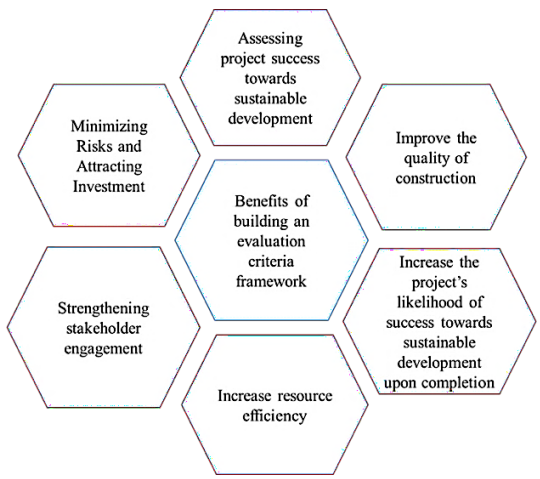

Figure 1. *Benefits of building an evaluation criteria framework*

Besides, many factors need to be analyzed and clarified to successfully build a criteria framework including the following 6 aspects: determining appropriate specific criteria to ensure feasibility, lack of collected data, lack of project complexity, cost and assessment time, stakeholder consensus, regulations and policies. The challenge of developing an evaluation criteria framework is depicted in Figure 2.

In addition, many factors need to be analyzed and clarified to successfully build a criteria framework including the following 6 aspects: determining appropriate specific criteria to ensure feasibility, lack of data collection, project complexity, cost and time of evaluation, consensus of stakeholders, regulations and policies. The challenge of building an evaluation criteria framework is described in Figure 2. After synthesizing related studies, this study proposed 21 standard values [3, 4, 5, 6]. In which, the study proposed 5 main groups including: time and cost efficiency, quality and safety efficiency,

environmental protection efficiency, social accessibility and affordability, humor please and add tricks (Table 1).

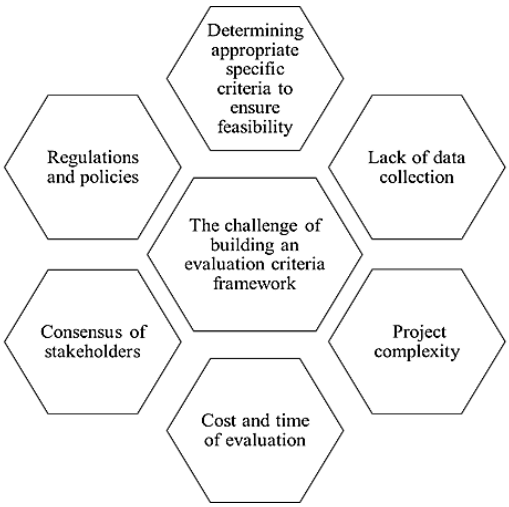

Figure 2. *Challenges of Developing an Evaluation Framework*

Table 1. *Symbols of evaluation criteria*

Stt	Criteria Symbols	Evaluation criteria
I	***TC***	***Time and cost effective***
1	TC1	Project Completion Time
2	TC2	Maintainability of housing facilities
3	TC3	Reduce life cycle costs
4	TC4	Reduce public spending on housing management
II	***CL***	***Effective in quality and safety***
5	CL1	Compliance with quality objectives
6	CL2	Aesthetic perspective of housing projects
7	CL3	Overall quality performance (cost, time, safety, quality).
8	CL4	Safety effectiveness (crime prevention)
III	***MT***	***Environmental protection efficiency***
9	MT1	Use environmentally friendly materials for construction
10	MT2	Energy efficient housing
11	MT3	Water-saving design and installation
12	MT4	Environmentally friendly (waste management, environmental standards compliance).
IV	***DK***	***Social accessibility and affordability***
13	DK1	Housing affordability
14	DK2	Affordability of Housing Rentals
15	DK3	Household travel expenses to the facility
16	DK4	Functions of housing facilities
17	DK5	Technology transfer/innovation
18	DK6	Housing facility take-up rate
V	***HL***	***Satisfaction and compliance with the law***
19	HL1	Legal Effectiveness (Compliance with Law and Legal Relationships Among Stakeholders)
20	HL2	Stakeholder satisfaction during project implementation
21	HL3	User Satisfaction

3. Research Methodology

3.1. Research process

The study proposes evaluation criteria frameworks to assess the effectiveness of investment projects in housing and commercial service construction in Nha Trang. The research diagram is illustrated in Figure 3.

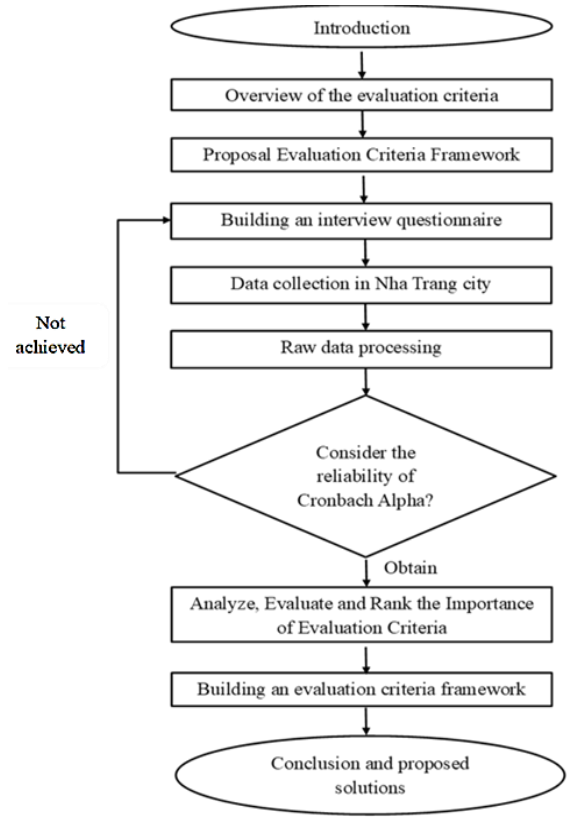

Figure 3. *Research diagram*

3.2. Collecting research data

This study collects data through a survey questionnaire. The survey aims to gather stakeholder opinions on the evaluation criteria framework for sustainable housing and commercial service investment projects in Nha Trang. The objective is to understand stakeholder perspectives and improve the effectiveness of future projects.

Table 2. *Statistical table of interview information by educational level*

Education Level	Number	Percentage %	Accumulation rate %
Intermediate	3	2.19%	2.19%
College	9	6.57%	8.76%
University	111	81.02%	89.78%
Postgraduate	14	10.22%	100%
Sum	137	100%	

The survey sample was built based on the diversity of participants' educational levels, types of organizations and work experiences. This helps ensure comprehensiveness and accuracy, reflecting many different perspectives on the effectiveness of construction investment projects. The participation of highly qualified and experienced experts further enhances the value and reliability of the survey results. According to Table 2, the educational level of the interviewees shows that 81.02% have university degrees, 10.22% have postgraduate degrees, 6.57% have college degrees and 2.19% have intermediate degrees. The high proportion of people with university degrees shows that the majority of participants have relevant knowledge and experience, creating an in-depth perspective on the criteria for evaluating the effectiveness of construction investment projects. The diversity in educational levels not only

improves the accuracy and reliability of the data but also ensures the inclusion of different perspectives, helping to build a more comprehensive and effective criteria framework.

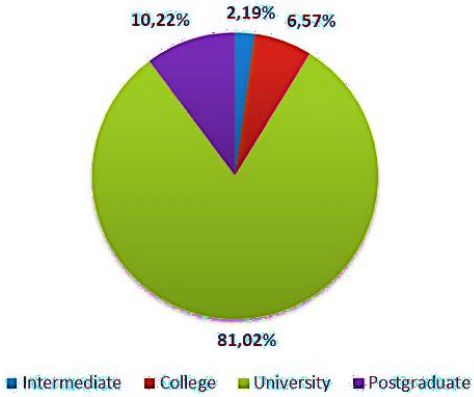

Figure 4. *The chart shows the level of education*

Table 3. *Statistical table of interview information by type of organization*

Organizational	Number	Percentage %	Accumulation rate %
State agency	22	16.06%	16.06%
Investor	12	8.76%	24.82%
Contractor	36	26.28%	51.09%
Design Consulting/ Supervision	42	30.66%	81.75%
Supplier	8	5.84%	87.59%
Expert, researcher	2	1.46%	89.05%
Other ingredients	15	10.95%	100%
Sum	137	100%	

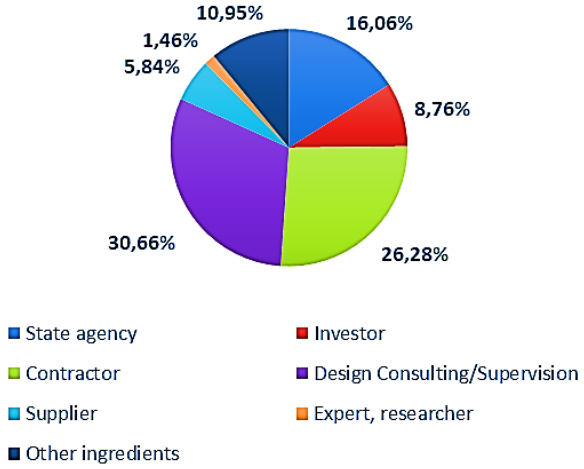

Figure 5. *The chart shows the organizational structure of the survey participants*

According to the type of organization of the interviewer (Table 3), the design consulting/supervision contractor group accounts for the largest proportion (30.66%), followed by the contractor group (26.28%) and the agency group state agencies (16.06%). Other groups account for 10.95%, while investors account for 8.76%, suppliers 5.84%, and research experts 1.46%. The diversity in the type of organization shows a strong presence of consultants and contractor teams, providing valuable information on the realities of project implementation and factors affecting performance. The presence of state agencies and research experts also supports access to official information and in-depth research, helping to build a more comprehensive framework of performance assessment criteria.

After synthesizing the survey results (Table 4), the analysis was based on the years of experience, job position, and type of organization of the interviewees. In terms of years of experience, the group with <= 5 years of experience used the maximum rate of 63.5%. Next was the group with 6-10 years of experience using 20.44%, the group with 11-15 years of experience using 8.03%, and the group with over 15 years of experience using 8.03%. Although the group of experts aged 11-15 and over 15 years of experience used a small proportion of the survey sample, they played a very important role in influencing the interview results.

Table 4. *Statistical table of interview information by type of organization*

Experience	Number	Percentage %	Accumulation rate %
≤ 5 year	87	63.50%	63.50%
6 – 10 year	28	20.44%	84%
11- 15 year	11	8.03%	92%
≥ 15 year	11	8.03%	100%
Sum	137	100%	

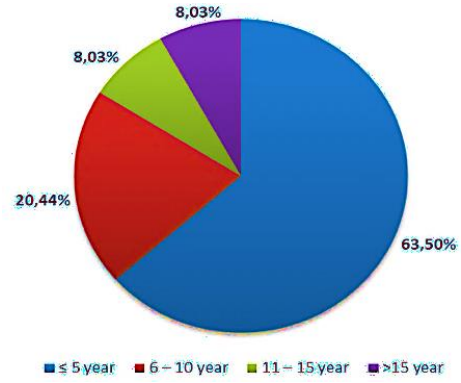

Figure 6. *Chart showing years of experience*

4. Results and discussion

4.1. Ranking of criteria

The study performed a classification based on the research criteria based on the mean values of the criteria. The data showed that the criteria on quality assurance (CL1), safety efficiency (CL4) and use of environmentally friendly materials for construction (MT1), environmental friendliness (MT4) occupied the highest positions, with CL1 having the highest mean value of 4.19. This shows that the standards related to quality and safety efficiency; environmental protection efficiency were highly appreciated in the analysis process. In contrast, the criteria on time and cost efficiency (TC) and social accessibility and affordability (DK), although having lower mean values, were still in the high range (from 3.978 to 4.066), indicating that they still play an important role but are less prioritized. The results are shown in Table 5.

The small difference between the mean values shows a high level of agreement between the assessments, with the

gap between the highest (CL1) and lowest criteria of reducing life cycle costs (TC3), reducing public expenditure on housing management (TC4), and household travel costs to facilities (DK3) being only about 0.21 points. This shows that there is not a large difference in priority between the criteria in the overall assessment process.

Table 5. *Ranking of evaluation criteria*

Criteria Symbols	Minimum	Maximum	Mean	Std. Deviation	Rating
CL1	1.0	5.0	4.190	0.9590	1
CL4	1.0	5.0	4.182	1.0016	2
MT1	1.0	5.0	4.168	1.0115	3
MT4	1.0	5.0	4.146	0.9742	4
TC2	1.0	5.0	4.131	1.0060	5
MT3	1.0	5.0	4.131	1.0133	6
CL3	1.0	5.0	4.131	1.1557	8
CL2	1.0	5.0	4.109	0.9828	9
DK1	1.0	5.0	4.066	0.9792	10
TC1	1.0	5.0	4.066	1.2497	10
HL3	1.0	5.0	4.058	1.2589	11
DK4	1.0	5.0	4.051	.9950	12
DK5	1.0	5.0	4.044	1.0493	13
MT2	1.0	5.0	4.044	1.0838	13
HL2	1.0	5.0	4.036	1.0738	14
DK2	1.0	5.0	4.015	0.9999	15
DK6	1.0	5.0	3.985	1.0360	16
TC4	1.0	5.0	3.978	1.0946	17
TC3	1.0	5.0	3.978	1.0810	17
DK3	1.0	5.0	3.978	1.0252	17

4.2. Cronbach's alpha reliability test

To assess the reliability of the survey data set, the Cronbach's Alpha coefficient is used [9]. This coefficient reflects the level of correlation between observed variables. Previous studies have shown that the Cronbach's Alpha coefficient is an effective tool to assess the reliability of data. According to Nunnally, when the Cronbach's Alpha value is 0.7 or higher, the scale is considered reliable [10]. In addition, the Corrected Item – Total Correlation index is also considered to assess the level of association of each variable with the remaining variables. According to the study of Cristobal et al. [11], factors with a total item correlation coefficient of less than 0.3 will be eliminated to ensure the accuracy of the scale.

Table 6. *Data reliability values*

Reliability value	Number of factors
0.980	21

Cronbach's Alpha coefficient was used to assess the reliability of the data with a value of 0.980 (Table 6), indicating that the data is of good quality. In addition, Table 7 presents the total correlation coefficient of each criterion. The results show that most of the total correlation coefficients have high values.

The study evaluated the Cronbach's Alpha coefficient for the hypothetical groups (Table 8). The results showed that all groups met the requirements, ensuring reliability for further analysis.

Table 7. *Overall correlation system for each criterion*

Criteria Symbols	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
TC1	81.453	312.911	0.719	0.980
TC2	81.387	314.754	0.854	0.978
TC3	81.540	313.927	0.813	0.979
TC4	81.540	312.765	0.834	0.978
CL1	81.328	315.855	0.865	0.978
CL2	81.409	314.685	0.878	0.978
CL3	81.387	313.812	0.760	0.979
CL4	81.336	314.872	0.855	0.978
MT1	81.350	314.185	0.866	0.978
MT2	81.474	313.516	0.822	0.979
MT3	81.387	313.812	0.875	0.978
MT4	81.372	317.677	0.795	0.979
DK1	81.453	314.294	0.893	0.978
DK2	81.504	314.458	0.868	0.978
DK3	81.540	314.691	0.839	0.978
DK4	81.467	313.854	0.891	0.978
DK5	81.474	314.310	0.829	0.979
DK6	81.533	313.795	0.855	0.978
HL1	81.489	315.340	0.849	0.978
HL2	81.482	314.502	0.803	0.979
HL3	81.460	314.000	0.687	0.980

Table 8. *Correlation coefficient of the total variables of the hypothesized groups*

Stt	Hypothetical group	Cronbach's Alpha coefficient
1	Time and cost effective	0.886
2	Effective in quality and safety	0.904
3	Environmental protection efficiency	0.944
4	Social accessibility and affordability	0.960
5	Satisfaction and compliance with the law	0.850

4.3. Exploratory factor analysis EFA

The KMO value in this study reached 0.959 > 0.6 and the sig coefficient of Bartlett's test was 0.000 < 0.05. This result proves that the variables are closely correlated with each other and are suitable for conducting EFA exploratory factor analysis.

Table 9. *KMO & Bartlett's Test coefficient*

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.959
Bartlett's Test of Sphericity	Approx. Chi-Square	3280.537
	df	190
	Sig.	0.000

After conducting EFA factor analysis using the PCA method with Varimax rotation and factor loading threshold of 0.5, the study identified 04 main components suitable to evaluate the effectiveness of housing construction investment projects. Residential and commercial buildings in Nha Trang. The rotation results of the four exploratory factors are presented in Table 10, clarifying the important criteria to consider.

According to the results in Table 10, factor MT1 has a factor loading coefficient expressed on 02 main factors, with the loading difference between the two factors being 0.019 (less than 0.2). However, MT1 still holds the 3rd ranking position out of 21 criteria, affirming its important

role in evaluating the effectiveness of residential and commercial construction investment projects in Nha Trang. Therefore, the study still retains MT1 in the factor with a higher loading factor, specifically factor 3. The results of the four factors discovered in the study are presented in Table 11.

The survey results clearly identify participants' priorities regarding quality, safety and environmental protection in project construction works, while emphasizing the importance of time and cost in the process.

Table 10. *Rotation matrix result*

	Main ingredients			
	1	**2**	**3**	**4**
DK3	0.801			
DK4	0.745			
DK2	0.736			
DK5	0.724			
CL2	0.693			
DK1	0.671			
CL1	0.640			
DK6	0.622			
CL4	0.610			
TC1		0.835		
CL3		0.810		
HL3		0.692		
HL2		0.549		
MT4			0.782	
MT2			0.717	
MT3			0.637	
MT1	0.577		0.596	
TC3				0.721
TC4				0.680
TC2				0.658
HL1				0.638

4.4. Proposed Evaluation Criteria Framework

Based on the analysis results in Table 11, this study proposes a criteria framework (Figure 7) to evaluate 04 exploratory factors in order: (1) Criteria group on the ability to ensure safety, quality and social access of the project (including criteria DK1, DK2, DK3, DK4, DK5, DK6, CL1, CL2, CL4); (2) Criteria group on evaluating project implementation efficiency (including criteria TC1, CL3, HL2, HL3); (3) Criteria group on environment (including criteria MT1, MT2, MT3, MT4); (4) Criteria group on project cost and legality (including criteria TC2, TC3, TC4, HL1).

The criteria for safety, quality and social access are crucial to the success of a project. Safety prevents risks and builds community trust. Quality ensures compliance with technical standards, improves efficiency and reduces repair costs. Social access benefits the community, especially vulnerable groups. This criteria not only ensures safety and quality but also connects the project to society.

Table 11. *Exploratory Factor Analysis*

	Main ingredients			
	1	**2**	**3**	**4**
DK3	0.801			
DK4	0.745			
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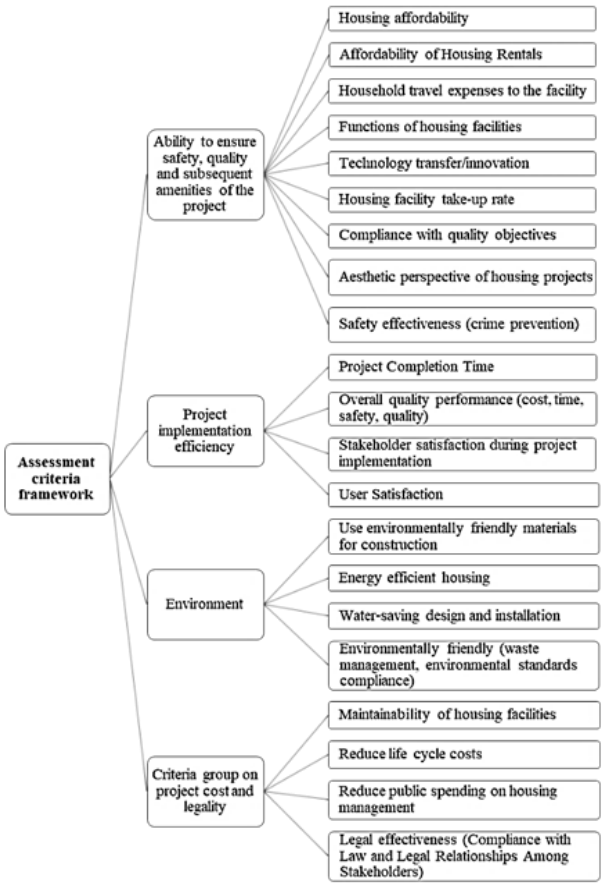

Figure 7. *A effectiveness assessment criteria framework of residential and commercial building construction investment projects toward sustainable development in Nha Trang city*

The project performance evaluation criteria help measure the economic, technical and social success of the project. This evaluation determines the level of completion based on progress, cost and quality, thereby optimizing resources and making timely adjustments to reduce risks. It also determines the value of the project to stakeholders, providing a view of economic and social benefits, contributing to improving sustainability and transparency in management.

Environmental criteria are an important factor in assessing the effectiveness of investment in building a solid level. The application of these standards helps to minimize negative impacts on the environment, control emissions, reduce waste and save resources. At the same time, it provides design tools that bring high performance and use green materials. Environmental assessment not only enhances the sustainability of the project but also increases the value of real estate, bringing economic and health benefits to residents. Investors and contractors can ensure compliance with environmental protection laws through this group of criteria.

Criteria group on project cost and legality is very important in evaluating the effectiveness of investment in building a solid program. This group of criteria helps to optimize the budget, ensure the effective use of investment accounts and avoid waste that can also occur when the main account is built and operated. Legally, this group of criteria ensures that the project is fully compliant with regulations and laws related to construction, school environment and planning, thereby avoiding legal acceptance and enhancing transparency, reliability, contributing to the sustainable development of the project.

5. Conclusion and recommendations

In summary, the development of a criteria framework for evaluating investment projects in housing construction and commercial services towards sustainable development in Nha Trang city has achieved positive results. This criteria framework allows for comprehensive evaluation of factors such as time, cost, quality, safety and satisfaction of stakeholders. The criteria are designed scientifically, feasible and sustainable, suitable for the context of urban development in Nha Trang. As a result, project evaluation becomes more transparent and systematic, helping to improve management, enhance the quality of works and meet the requirements of local sustainable development. To enhance the application of the criteria framework in the future, we propose the following solutions:

- Apply the criteria framework: Expand its application in construction projects in Nha Trang.
- Regular updates: Periodically evaluate to adjust the criteria framework according to local realities.
- Enhance coordination: Encourage cooperation between investors, authorities and stakeholders.
- Raise awareness: Organize training on sustainable development for stakeholders.
- Monitor project effectiveness: Evaluate project effectiveness after completion to ensure sustainability.

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