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Investigation Study of the Challenges in Green Procurement Implementation in Construction Projects in UAE

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Abstract

The global construction industry is responsible for significant environmental and societal effects. Some researchers claim that it accounts for 35% of global gas emissions. One of the solutions is to practice green supply chain management. Part of this is Green Procurement (GP) to conserve energy and money. However, challenges in implementing green procurement in the construction industry are rising. This research aims to identify the most significant challenges when implementing green procurement (GP) in construction projects in the UAE. A comprehensive article review was conducted to determine the critical obstacles highlighted by different researchers. These challenges were prioritized using the analytical hierarchy process (AHP) method, and then recommendations on best practices to overcome these challenges were proposed. The results show that the lack of top management commitment is the biggest challenge when implementing green procurement in the construction industry in the UAE, with a priority value of 0.331, followed by a lack of knowledge, with a value of 0.2748. In contrast, lack of awareness is the lowest-ranked factor, with a value of 0.103.

Keywords: Green Procurement; Construction Project; Challenges; AHP.

1. Introduction

As the global population rapidly rises, the demand for more resources, such as energy, water, and food, has also increased, accelerating greenhouse gas emissions (GHGE). One of the most significant contributors to gas emissions is the construction industry. Rais et al. [1] stated that construction activities cause many environmental problems, such as noise, air pollution, waste, and water pollution. Subramanian [2] claimed that the building industry consumes about 40 percent of the extracted materials and is responsible for 35 percent of CO_2 emissions. Crawford [3] claimed that the construction industry accounts for about 39% of global greenhouse gas emissions.

One of the best practices to reduce this is to implement green supply chain management (GSCM). An essential part of GSCM is green procurement, which has been extensively studied in the literature [4]. Procurement is the process of acquiring the goods you need to run your business. On the other hand, supply chain management is concerned with how those supplies are turned into finished goods and distributed to customers. Procurement is concerned with obtaining supplies; supply chain management is concerned with all this and more. The investigation of GSCM in general and green procurement was accomplished with two critical goals: analyzing barriers and challenges and proposing a strategy or success factors for green implementation. Al Nuaimi et al. [5] considered implementing sustainable procurement in the United Arab Emirates (UAE) public sector. This study is limited to analyzing and prioritizing the most effective

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barriers and challenges using one of the most effective multi-criteria decision-making methods: the Analytic Hierarchy Process (AHP). Al While green procurement was extensively investigated in the literature, little was published about using the AHP to analyze the importance of different barriers and challenges, at least in the Middle East. The AHP method is a reliable yet easy decision-making tool.

2. Literature Review

GSCM was studied widely in previous studies, especially in the construction sector. For example, Subramanian [2] investigated a GSCM approach to assess barriers, consisting of nine constructs. These constructs positively impact environmental, economic, and organizational performance. Wibowo et al. [6] developed another framework for GSCM implementation for the construction industry. To create the model, they used the Delphi method. Moreover, Ahmed [7] investigated critical barriers hindering the adoption of GSCM. In that study, 163 professionals provided data, and 15 interviews were conducted with professionals from 11 developing countries. The data from the construction professionals was obtained through an online survey. The top four barriers were determined. Some studies concentrated on the UAE construction sector. For example, Balasubramanian [8] developed a structural analysis of the enablers of GSCM in the UAE construction sector using an Interpretive Structural Modeling (I.S.M.) approach. Another example is the study by Balasubramanian & Shukla [9]. A comprehensive GSCM in the construction sector was developed in the UAE construction sector context, where information was gathered through semi-structured interviews.

On the other hand, some studies have investigated the green procurement process. For example, Iyer-Raniga & Finamore [4] investigated the reuse of materials during the new construction phase. They used the case study approach in Italy. The review approach was utilized in their study to scan past research on green public procurement (GPP) in terms of ecologically responsible behavior and policy implementation [10]. Moreover, Khodaparasti et al. [11] investigated product-based green procurement practices in manufacturing small- and medium-sized enterprises (SMEs). They found that environmental concerns, employee competency, motivation, and rewards significantly affected adopting product-based green procurement practices.

Furthermore, Bidin et al. [12] investigated the challenges and drivers of green procurement among construction practitioners in Malaysia. Some studies investigated green procurement in the construction sector in the UAE, such as Al Kukhun [13], where the study compared the construction industry's present procurement procedures to green procurement needs for transformation. Results showed that the lack of customer input and environmental requirements in contract documents were the primary gaps between current and green procurement. Another study in the UAE is Al Nuaimi & Khan [14], which focused on public-sector green procurement. Results showed that the organization's innovation capability has a positive influence on green procurement implementation. However, some studies were published about using the AHP method in GSCM in the green procurement process in the public, manufacturing, and construction sectors. Besbes [15] described a two-phase mathematical programming approach for supply chain design that takes into account the product life cycle and environmental impact. The model includes a combination of the AHP and the aggregation models for performance evaluation. Another study by Luthra et al. [16] used the AHP method to identify and rank strategies for implementing GSCM in the Indian manufacturing industry. Four strategic dimensions were discovered to be critical to greening supply chains and improving operational performance.

Moreover, Govindan et al. [17] made a barriers analysis for GSCM based on procurement effectiveness, and implementation in Indian industries using AHP A total of 47 barriers were identified through a questionnaire-based survey as well as detailed literature and discussions with industry experts. Parmar [18] investigated the barriers to GSCM implementation in India's S.M.E.s. The barriers were ranked using interpretive structural modeling (I.S.M.) and fuzzy AHP. The findings aid S.M.E.s in developing an economically and environmentally sound supply chain network. Mohammadjafari et al. [19] studied the barriers to GSCM implementation in Iranian industries using AHP. Using both detailed literature and discussions with industry experts, a total of 20 barriers were identified. Then, using the AHP process, essential barriers/priorities are identified. In a study by Singh [20], the AHP method was applied to evaluate and rank critical success factors for automobile companies implementing.

Ahsan & Rahman [21] investigated the challenges of implementing green procurement in the Australian public healthcare sector. They developed a new framework for implementation based on an extensive literature review. AHP Another study conducted by Dianawati & Perdana [22] combined both AHP and TOPSIS to assess the procurement process. Metham et al. [23] developed the Green Road Incentive Procurement System (GRIP) to encourage contractors to use environmentally friendly construction methods. AHP was used to evaluate opinions. Results showed that the stakeholders accepted the proposed method.

To conclude, this study will fill in the research gap by investigating the most critical barriers and challenges facing green procurement in the construction sector in the UAE. Therefore, the barriers found in the literature are listed as shown in Table 1.

Table 1. Challenges in G.P. implementation

Lack of top management commitment	C1
Lack of knowledge	C2
High cost of green products	C3
Lack of awareness	C4
Insufficient policies and regulations promoting green procurement	C5
Lack of enforcement by the government	C6
Lack of incentive for companies	C7
Limited supply of green products	C8
Insufficient qualified staff	C9
Lack of proper guidelines for implementation	C10
Insufficient research and development	C11
Perception of green products	C12
Lack of training for procurement officers	C13
Lack of practical tools	C14
Poor market demand for recyclable material	C15

However, different researchers have different points of view on the challenges that may affect the implementation of green procurement in construction projects. Table 2 summarizes the different researchers and the challenges that they identified.

Table 2. Challenges referred in reviewed articles

Possible Challenges (Cs)	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**	**C11**	**C12**	**C13**	**C14**	**C15**
Rais et al [1]		●								●					
Bidin et al. [12]	●			●					●	●					
Ahsan & Rahman [21]	●			●	●	●	●	●							
Min and Galle [24]		●		●			●						●		●
Bouwer et al. [25]	●		●												
Varnäs et al. [26]	●	●	●						●			●			
Fischer [27]	●											●			
Sourani & Sohail [28]		●	●		●	●	●								
Adham & Siwa [29]	●	●	●			●	●	●	●	●					
Mensah & Ameyaw [30]					●			●			●				
Gunther [31]	●		●		●	●									
Zhu et al. [32]					●	●									
Appolloni et al. [33]			●		●			●							
McMurray et al. [34]	●			●			●								
Bohari & Xia [35]	●			●	●		●			●	●	●		●	
Ruparathna & Hewage [36]	●		●	●											
Buniamin, et al. [37]		●													
Wong at al. [38]				●			●								
Carlsson & Waara [39]		●		●		●		●						●	
Rashidi et al. [40]			●					●					●		
Aldenius & Khan [41]	●	●	●			●			●		●				
Bidin et al. [42]	●	●		●	●				●		●				
Total	**12**	**9**	**9**	**9**	**8**	7	7	6	5	4	4	3	2	2	1

The AHP method was used to prioritize criteria used in alternative selection [43–45]. However, the AHP method can convert complex problems into a hierarchical structure consisting of different levels, such as goals, criteria, and sub-criteria [46–49]. Therefore, this study uses the AHP method to analyze and prioritize the significant challenges in green procurement implementation in the construction sector in the UAE. Based on the author's knowledge, few, if any, researchers have covered this area of expertise.

3. Research Methodology

The research methodology is designed based on three main sequential steps: a comprehensive literature review, data gathering, and AHP implementation. However, the detailed research methodology steps were:

Step 1: A comprehensive literature review focuses on the challenges when implementing G.P. to select the most frequent challenges that appeared in the literature, as shown in Table 2.

Step 2: Data was gathered using a specially designed questionnaire based on the Saaty scale to create a pairwise comparison table. The questionnaire was distributed to construction experts and other specialists. Respondents were asked to compare factors together. A dropdown menu was provided for them to select the appropriate values, as presented in Figure 1.

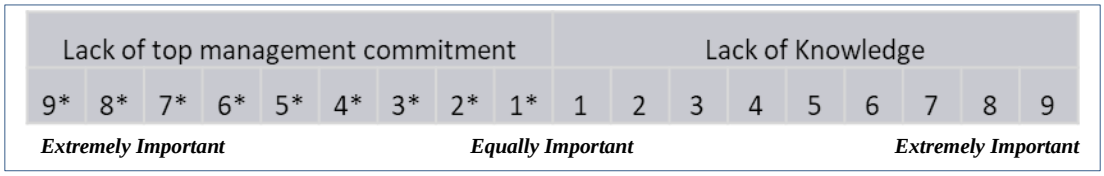

Figure 1. Question structure (Example: C1 vs. C2)

Step 3: The questionnaire is scored using the Saaty scale ranging from 1 to 9 to determine whether two factors are equally important or more important than the other, as shown in Table 3 [46].

Table 3. Pairwise scale

Importance scale	Definition of Importance Scale
1	Equally Important Preferred
2	Equally to Moderately Important Preferred
3	Moderately Important Preferred
4	Moderately to Strongly Important Preferred
5	Strongly Important Preferred
6	Strongly to Very Strongly Preferred
7	Very Strongly Important Preferred
8	Very Strongly to Extremely Important Preferred
9	Extremely Important Preferred

Step 4: This research concentrates on the top five challenges ranked based on the questionnaire results, as shown in Table 4.

Table 4. Top Five Challenges

Challenges	Times Referred	Code
Lack of top management commitment	12	C1
Lack of knowledge	10	C2
High cost of green products	9	C3
Lack of awareness	9	C4
Insufficient policies and regulations promoting green procurement	8	C5

Step 5: Implementing the AHP method to prioritize the challenges. There are five steps to applying AHP methodology among a set of criteria. These steps are [45]:

I. The determination of the challenges to be compared is shown in Table 4.

II. Developing the pairwise Matrix. An example of display consistency for two factors is shown in Table 5.

Table 5. AHP Pairwise matrix

	Criterion 1	Criterion 2
Criterion 1	1	Numerical rating
Criterion 2	1/ Numerical rating	1

III. The pairwise Matrix must be normalized by dividing each number by the sum of its column.

IV. Each criterion's weight was calculated using the priority vector (Eigenvector). By calculating the average of each criterion (each raw).

V. Calculation of the consistency index as in the following sub-steps [45]:

- Calculating the consistency index CI, using Equation 1, where n is the number of criteria in the comparison.

$$\text{CI} = \frac{\text{Max Eigen value} - n}{n-1} \quad (1)$$

- Then divide its value by the random consistency index, which is stated by Saaty depending on the importance of n. the results are shown in Table 6 [46].

Table 6. Random consistency index

n	3	4	5	6	7	8	9	10	11	12	13
RI	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51	1.48	1.56

- Calculate the Consistency Ratio (C.R.) value using Equation 2, where a value below 10% is considered consistent. Where CI is the Consistency Index, and R.I. is the Random Consistency Index.

$$\text{CR} = \frac{CI}{RI} < 0.1\sim10\% \quad (2)$$

Figure 1, shows the flowchart of the research methodology through which the objectives of this study were achieved.

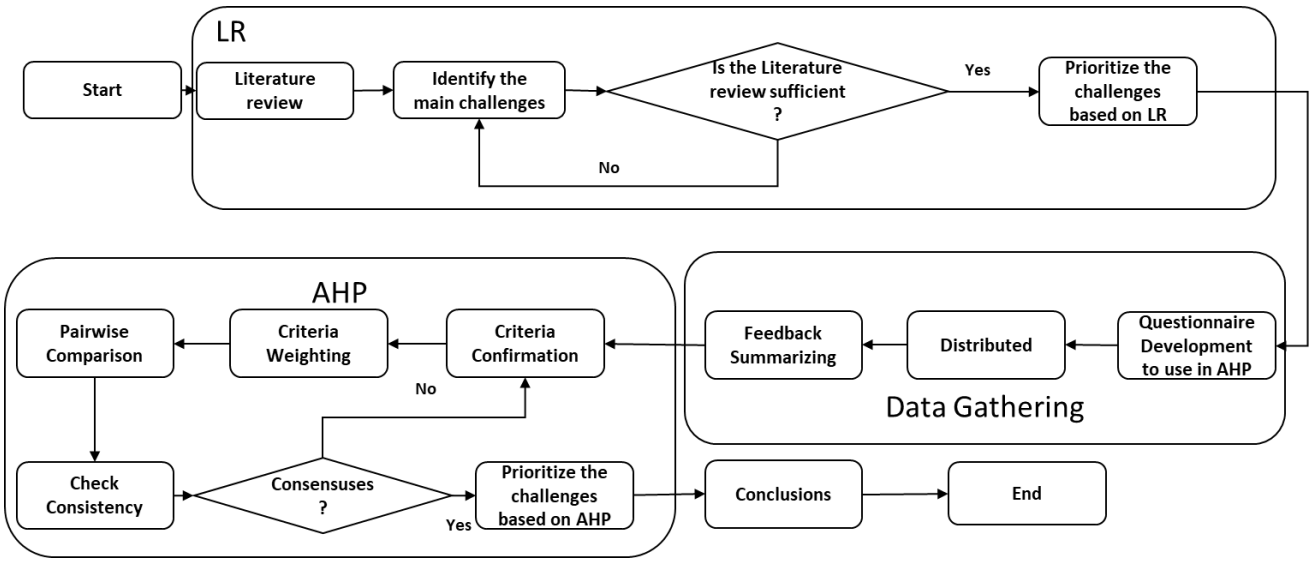

Figure 2. Research methodology flow chart

4. Results and Analysis

The questionnaire was designed to evaluate the critical challenges of green procurement implementation in the UAE construction sector. Experts and practitioners in the construction industry participated in the questionnaire. The survey was distributed through Google Docs, where 30 people responded to the questionnaire. Descriptive statistics show that most respondents (40%) are under 25 years old, and 80% are engineers, as shown in Figures 3.

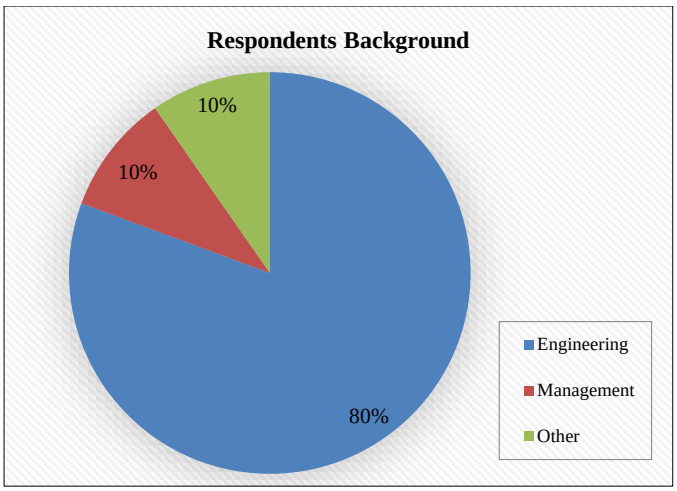

Figure 3. Respondent's background

Finally, the analytical hierarchical process (AHP) method was used to mathematically prioritize the challenges of green procurement in construction projects in the UAE. The AHP method is a structured sequence method. There are five steps to applying the AHP methodology, among a set of criteria. These steps are:

1. The questionnaire results were used as a basis for the judgment of the criteria used in developing the comparison matrix, the priority vector, and the inconsistency, as shown in Table 5, which shows how the pairwise matrix is created.

   AHP, therefore, the pairwise Matrix for the five factors is shown in Table 7.

Table 7. Pairwise matrix

	Factor 1	Factor 2	Factor 3	Factor 4	Factor5
Factor 1	1.000	6.000	1.000	1.000	5.000
Factor 2	0.167	1.000	5.000	5.000	5.000
Factor 3	1.000	0.200	1.000	3.000	0.130
Factor 4	1.000	0.200	0.330	1.000	1.000
Factor 5	0.200	0.200	8.000	1.000	1.000
Sum	**3.367**	**7.600**	**15.333**	**11.000**	**12.125**

2. The pairwise Matrix then normalized by dividing each number by the sum of its column as shown in Table 8.

Table 8. Normalized matrix

	Factor 1	Factor 2	Factor 3	Factor 4	Factor5
Factor 1	0.29703	0.789474	0.06522	0.090909	0.41237
Factor 2	0.04950	0.131579	0.32609	0.454545	0.41237
Factor 3	0.29703	0.026316	0.06522	0.272727	0.01031
Factor 4	0.29703	0.026316	0.02174	0.090909	0.08247
Factor 5	0.05941	0.026316	0.52174	0.090909	0.08247

3. The priority vector (Eigenvector) was determined by averaging the row entries in the normalized Matrix as shown in Table 9.

Table 9. Priority vector

Factor	F1	F2	F3	F4	F5
Priority	0.331	0.27482	0.13432	0.10369	0.15617

4. Calculation of the consistency index as shown in Table 10.

Table 10. Consistency Index

Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Sum	λ_{max}
0.33100	1.648905	0.13432	0.103694	0.78084	2.99876	9.05970
0.05567	0.274817	0.67160	0.518468	0.78084	2.30090	8.37245
0.33100	0.054963	0.13432	0.311081	0.01952	0.85089	6.33477
0.33100	0.054963	0.04477	0.103694	0.15617	0.69060	6.66000
0.06620	0.054963	1.07456	0.103694	0.15617	1.45559	9.32059
						Avg. = 7.94950

Cl = 0.737375; CR = 0.658371

A critical analysis of the responses to the questionnaire was performed to create the pairwise comparison table. As shown in Table 4, the two factors that are being compared are listed first. If one factor is more important than the other, its numerical value is written on the importance scale.

A pairwise comparison matrix of the five factors is established based on the judgments made by the respondents. Next, the AHP method was applied to determine the weights of relative importance for each factor. The geometric means of the pairwise comparisons and their priority weights are calculated for each factor. The highest priority value represents the biggest challenge, and the lowest priority value represents the smallest challenge. The results are summarized in Table 8. Generally, AHP compares the relative importance of each factor by breaking them down into a hierarchy of criteria and sub-criteria and assigning weights to each factor. This allows for more informed decision-making based on the weightings given to each factor.

The results indicate that the lack of top management commitment is the most important challenge when implementing green procurement in the construction industry in the UAE, with a priority value of 0.331. The lowest-ranked factor is lack of awareness, with a value of 0.103. Ranking the challenges according to their priorities shows that lack of top management commitment has the highest priority, followed by lack of knowledge. Insufficient policies and regulations promoting green procurement, the high cost of green products, and a lack of awareness are in ranks 3, 4, and 5, respectively. Without top management's commitment, there is no incentive for employees to take green initiatives seriously. Without a clear directive from the top, employees will not be motivated to take ownership of the green goals and will not be held accountable for their actions. Policies and regulations promoting green procurement are necessary. For example, organizations can provide guidance on how to evaluate and compare the environmental impact of goods and services, as well as how to incorporate environmental criteria into the selection and award processes. In comparison to the other factors, top management commitment and lack of knowledge have relatively higher priority values, which indicates that they can be more challenging than the other factors. These two factors are key drivers of success, as they provide direction and guidance to the team. Additionally, they ensure that the right resources are made available to the team in order to achieve the desired results. To verify our findings, we interviewed an expert in the construction field with 15+ years of experience. The expert agreed with our findings about the AHP method. We believe this adds further weight to our conclusions, as the expert had extensive knowledge of the industry and the AHP method. Furthermore, their agreement highlights the accuracy of our research method.

In this context, it is well known that green procurement necessitates commitment from all levels of the organization, not just top management but also purchasing officers. The lack of organizational procedures and guidelines leaves companies incapable of addressing sustainability problems, which means the final decision will be made based on how interested top management is in green procurement. In order to facilitate success in the sustainability transition, top management must buy into sustainability and align their values with the government's sustainability agenda in order to facilitate a successful transition from traditional procurement to sustainable procurement. One of the criteria for integrating sustainability into an organization's procurement process is ISO 20400. ISO 20400 is an international standard that outlines the requirements for integrating sustainability into the daily operations of an organization. It includes principles such as minimizing environmental impacts, promoting economic development, and ensuring ethical labor practices.

Many experts believe that construction companies and developers are either illiterate or unaware of the benefits of green procurement in the construction industry. Due to a lack of clear definitions of sustainable building, regulatory restrictions, and knowledge about sustainable materials, the concept of sustainable development is unclear or has negative viewpoints on it. There is a noticeable lack of real-world experience, making it difficult for them to put theory into practice. Seminars and workshops on green procurement can be beneficial in spreading knowledge and solving the lack of knowledge problem.

It is very clear that the government plays a critical role in fostering construction sustainability. With the help of laws and regulations, sustainable development can be perfectly enforced. While the UAE government has proposed several regulations on sustainability, further compliance and monitoring are needed. The government can take more steps to

develop new legislation and provide incentives to businesses that use green procurement. Nonetheless, the UAE government has taken steps to incorporate green building practices into its policies. For example, Abu Dhabi's government unveiled Vision 2030, a plan to grow the emirate by incorporating sustainability into three main pillars: environment, economy, and social vision.

The cost of introducing green procurement is a major consideration. Despite the advantages, policymakers are hesitant to make such a decision and go over their organization's budget due to the high cost of available green goods on the market and their relative life cycle costs. Many experts believe that the costs associated with developing sustainable suppliers and partners, as well as the infrastructure and training costs, deter organizations from investing. Since the construction strategy and material selection for green buildings differ from traditional buildings, sustainability has a reputation for being more costly. It does not, however, always have to be at an additional expense. Sustainable practices are thought to raise short-term project costs due to the upfront costs of environmentally friendly construction. However, in the long run, they lead to lower project costs.

The UAE has an abundance of wealth, which is reflected in the extravagant expenditure on various things such as water and energy use, which exceeds that of many other countries on a per capita basis. As a result, the desire for reform, which is the primary motivator for change, does not exist. There is a complete lack of understanding of the advantages of green construction over conventional construction. There is a widespread belief that green buildings are more costly and that the extra expense at the construction stage is unjustifiable. As a result, there is a lack of willingness to adjust.

Comparing the results of this study with the literature review, let us refer to Table 2 again. The barriers that were mentioned in Table 3 were ranked based on the frequency with which they were mentioned in the literature. The same ranking of barriers in that table was also found in the AHP results of this study, where lack of top management commitment was the most important barrier. For example, involvement and support by the top management, government, and public were found to be the top barriers in the study by Ahmed et al. [7]. These results coincide with those of the current paper. Furthermore, the commitment of top management and government in the U.A.E. was emphasized by the study of Al Nuaimi et al. [5]. Moreover, cost implications were found to be the most important barrier in the study by Parmar [18]. Lack of knowledge about green practices was also found to be one of the most important factors in the same study. Moreover, lack of knowledge was found to be the most important barrier in the study by Rais et al. [1]. Therefore, both the literature review and experts' opinions validate the results of this study. This shows that the research is reliable and valid and can be used to draw meaningful conclusions. The findings of this study can be used to develop effective strategies and policies to address the issue at hand.

5. Conclusion

This research investigates the most critical barriers and challenges facing green procurement practices in the construction sector in the UAE. The study analyzed the literature to identify and prioritize the main difficulties of better implementation of green procurement using the AHP process as one of the most effective methods in multi-criteria decision-making. The results showed the following: The most significant challenges are a lack of top management commitment, a lack of knowledge, the high cost of green products, a lack of awareness, and insufficient policies and regulations promoting green procurement. The AHP method was used to prioritize these challenges. The results indicate that the lack of top management commitment is the most crucial challenge when implementing green procurement in the construction industry in the UAE, with a priority value of 33%, followed by a lack of knowledge with 27%, insufficient policies and regulations with 16%, and the high cost of green products with 13%. The lowest-ranked element is lack of awareness, with a value of 10%. These results aligned partially with the literature that shows the most significant factors are top management commitment and lack of knowledge, with a total of 60%.

6. Declarations

6.1. Author Contributions

Conceptualization, M.M., K.S., and M.H.; methodology, I.B., M.M., and K.S.; software, M.A.; validation, A.S., I.B., and M.A.; formal analysis, M.M. and K.S.; investigation, M.H, I.B., and A.S.; resources, M.A., M.M., and K.S.; data curation, M.M. and K.S.; writing—original draft preparation, M.M. and K.S.; writing—review and editing, M.H., A.S., I.B., and M.A.; visualization, M.H.; supervision, M.H.; project administration, M.H. All authors have read and agreed to the published version of the manuscript.

6.2. Data Availability Statement

The data presented in this study are available on request from the corresponding author.

6.3. Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

6.4. Conflicts of Interest

The authors declare no conflict of interest.

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