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Challenges for Implementing Environmental Management Plans in Construction Projects: The Case of Malaysia

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Abstract: An environmental management plan (EMP) can reduce the impact of construction projects on the environment. While there is an increasing trend to promote sustainability, effective EMP implementation in Malaysia is limited. In this study, we aim to investigate the challenges for implementing EMP at construction sites in Malaysia, identify the main issues among those challenges, and determine the interrelationships between the main challenges. We identified 30 potential challenges for implementing EMP through a systematic literature review of 41 papers and semi-structured interviews with 20 construction industry professionals. Subsequently, a survey was used to solicit opinions on the challenges. The collected data were analyzed using mean score, standard deviation, normalization, factor analysis, and analysis of variance (ANOVA). The results illustrate that 21 main challenges exist for implementing EMP in Malaysia. From these, eight main challenges can be grouped into two major components: people- and project-related challenges. ANOVA test results suggest different perceptions of the challenges between project owners, contractors, and consultants. The theoretical implications of this study include a profound understanding of the challenges in implementing EMP at construction sites in Malaysia and their underlying relations.

Keywords: sustainable development; construction industry; project management; sustainable construction; environmental management plan

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Citation: Asnor, A.S.; Al-Mohammad, M.S.; Wan Ahmad, S.; Almutairi, S.; Rahman, R.A. Challenges for Implementing Environmental Management Plans in Construction Projects: The Case of Malaysia. *Sustainability* **2022**, *14*, 6231. https://doi.org/10.3390/su14106231

Academic Editor: Choongwan Koo

Received: 20 April 2022
Accepted: 16 May 2022
Published: 20 May 2022

1. Introduction

There is an increasing trend toward adopting the sustainable development concept to minimize climate change [1]. The key principles of sustainable development include improving people's quality of life and health and supporting systems that provide a country with natural resources [2]. Therefore, governments have developed initiatives to motivate construction projects to implement environmental management plans (EMPs) [3]. The construction industry is a sector that contributes significantly to economic development. However, the construction industry is not environmentally friendly and has adverse effects on society [4]. Construction projects consume a significant amount of energy and natural resources and produce a considerable amount of air, water, noise, and land pollution. In addition, construction and demolition wastes generated by the construction sector have negative impacts on the environment (water, soil, and air pollution), economy (loss of primary resources), and public health (health hazards and public space consumption). These problems negatively affect different external stakeholders. Table 1 shows examples of different impacts of construction projects on the environment [4–7]. Ground surface disturbances resulting from construction activities considerably increase pollution damage [8]. Clearing and excavation activities lead to soil erosion and sedimentation, thereby continuing to cause environmental degradation [9]. In addition, some steep mountainous land has been converted to arable land, resulting in erosion and sediment problems owing to terrain changes [10]. Therefore, without proper EMP, the negative impact of the construction industry on the environment will remain a serious threat to the world and humankind.

Table 1. Estimated impact of construction projects on the environment.

Estimated Impact of Construction Projects on the Environment Globally			Reference
Consumption	Energy	36% to 42%	[4–7]
	Resources	34%	[4]
	Freshwater	12% to 25%	[4–6]
	Raw materials	30%	[6]
	Land	12%	[6]
Releases	Solid waste	25% to 40%	[4–7]
	Greenhouse gases	30%	[4,5]
	Water effluents	20%	[6]
	Other types of pollution	13%	[6]

While this emphasizes the need for a more efficient management plan for the impact of construction activities on the environment, project stakeholders have little conscious awareness and understanding of implementing EMPs [5,11,12]. Such awareness and understanding can be achieved by seeking professional advisors; however, most stakeholders do not choose this option [13]. In addition, project stakeholders are not optimistic about implementing EMPs because the benefits and competitive advantages are relatively low [14]. On the contrary, poor EMP implementation is expected in light of a lack of industry standards, comprehensive rules and regulations, and clearly defined responsibilities [15–17]. This issue is especially true for Malaysia. There is a lack of environmental policies and regulations to enforce environmental sustainability and monitor the practices of construction organizations. Moreover, construction firms in Malaysia spend less on social responsibility activities to protect the natural environment [18]. In a technical sense, financial aspects such as incentives and high implementation costs are also important [19,20]. Project managers must make long-term commitments to allocate resources before and during EMP implementation. The high cost of EMP implementation in Malaysia remains a critical challenge because it increases the financial burden on project stakeholders, especially contractors [21].

As the level of resources varies among countries, not every nation can implement EMPs at the same pace. Governments in developing countries, including Malaysia, lack initiatives such as financial facilitation and mandates for EMP implementation [22]. Furthermore, the attitude of project stakeholders towards sustainable practice and EMP implementation varies in different construction industry contexts [18]. Therefore, region-specific research on the challenges in EMP implementation is necessary. A review of the existing literature suggests that the challenges facing EMP implementation have been widely studied. However, a limited amount of research has emphasized the identification and understanding of the challenges for implementing EMPs in Malaysia. Understanding the challenges of EMP implementation provides valuable information for protecting the environment. Moreover, project stakeholders can identify the shortfall areas, especially in Malaysia, that require greater improvement in EMP practices.

This study aims to investigate the challenges for implementing EMPs at construction sites in Malaysia, identify the main issues among those challenges, and determine the interrelations between the main challenges. In this study, EMP is defined as a document containing the organizational structure, responsibilities, procedures, and resources to deal with all relevant environmental issues and achieve effective and long-term compliance in environmental protection. The document intends to outline the actions to manage the impacts of project activities. The EMP is designed to ensure appropriate measures are taken to handle the significant environmental impact issues that are most likely to arise during the construction and operational phase of a project [22].

2. Literature Review

2.1. Challenges in EMP Implementation

Although implementing EMPs can lead to sustainable development, it involves several challenges. In developed countries, the construction industry attributes low EMP implementation to low environmental awareness and few potential benefits as well as the lack of knowledge of EMP implementation [16]. Poor knowledge and awareness make EMP implementation unnecessary due to the lack of motivation. According to Refs. [4,23,24], there is a negative attitude among construction industry professionals in the UK and Australia toward EMP implementation. Such attitudes negatively affect the commitments of the client, contractor, and consultant towards the environment [4]. Significant responsibility is placed on governments for developing initiatives such as media campaigns, education programs, and incentives, as important promotion strategies for implementing EMPs [25,26]. In addition, defining the roles and responsibilities of the project parties is vital to ensure all parties play an active role and share commitments in protecting the environment; Italy, the Netherlands, and France are lacking in this area [17]. In addition to unclear roles and responsibilities, construction industry professionals in Hong Kong claim a high implementation cost of environmental management systems, which affects the performance of the construction projects [12].

While these challenges persist in developed countries, construction industry professionals in developing countries, including China, refuse to consider EMPs due to the high implementation costs [2]. Implementing EMPs requires sufficient financial resources to afford skilled personnel, machinery, equipment, and advanced materials [20]. These challenges are especially true for contractors who prefer to avoid payments for any unnecessary work due to new operating costs [6]. There is also a lack of comprehensive rules and regulations and insufficient staffing to promote sustainability [3]. Environmental regulations provide controlling measures to minimize pollution from construction activities through different procedures [17]. Ghana and Malaysia also experience some challenges in promoting sustainability. In Ghana, the challenges of EMP implementation include a shortage of qualified personnel, lack of knowledge, and high implementation costs [14,19]. Ref. [18] reported the importance of government pressure regarding policies and regulations for environmental sustainability performance in Malaysia. Ref. [27] concluded that the awareness of the management of construction and demolition wastes, stakeholders' commitment, and the cost of protecting the environment are the key factors in promoting environmental sustainability. Ref. [28] found that not all contractors, including large contractors, medium-size contractors, and small contractors, are willing to pay for improved construction waste management.

2.2. Positioning This Study

Construction activities have a negative impact on the environment. The success in decreasing these impacts can improve the performance of construction projects towards cleaner production. Therefore, controlling the environmental impacts of construction activities is vital. One solution to achieving this goal is to implement an EMP. Although EMPs can help reduce pollution damage and maintain sustainability, many challenges hinder their implementation. Therefore, understanding the challenges of implementing EMPs at construction sites is important to formulate proper strategies to overcome these challenges. Prior works have investigated the challenges to EMP in both developed and developing countries. However, the investigation of the sustainability practices in Malaysia has focused on environmental sustainability in general and construction waste management. The above review suggests that the existing body of knowledge on the challenges of implementing an EMP at construction sites in Malaysia is limited. Therefore, this study attempts to answer the following questions: (1) What are the challenges for implementing an EMP at construction sites in Malaysia? (2) What are the main challenges in implementing an EMP at construction sites in Malaysia? (3) What are the underlying relations between the main challenges?

3. Method

This study involved both qualitative and quantitative approaches. The qualitative part entails conducting semi-structured interviews with construction industry professionals to obtain in-depth information with regard to EMP implementation challenges. In contrast, the quantitative part analyzes the data of the EMP implementation challenges collected using the survey. Figure 1 shows the study design, adapted from [21,29]. The next subsections describe the methodology in detail.

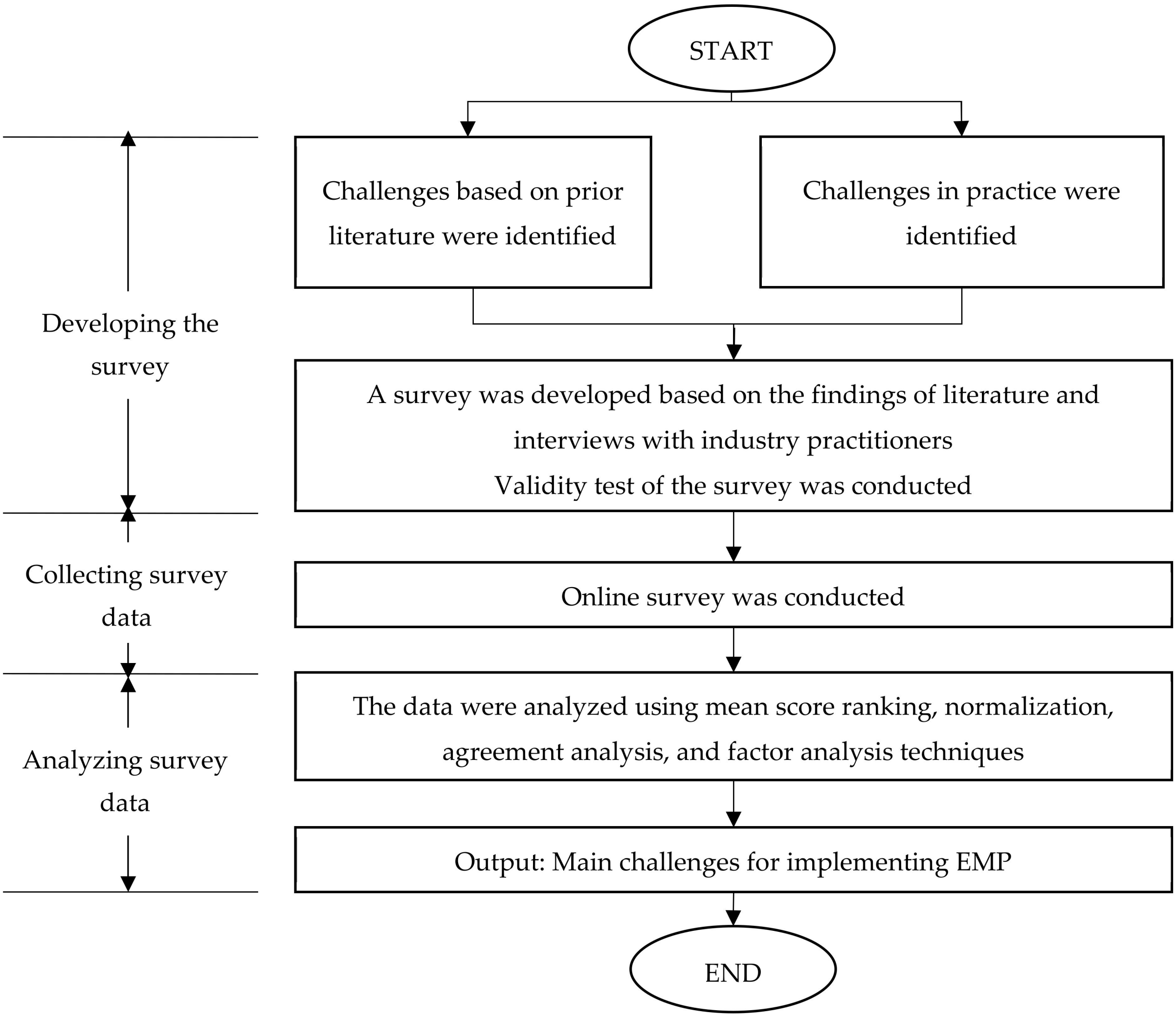

Figure 1. Study design (adapted from Refs. [19,27]).

3.1. Survey Development

We herein adopted the survey approach to obtain broad perceptions of construction industry professionals of the challenges of EMP implementation. The advantages over other data collection methods include capturing a wide spectrum of responses to represent a wider population. A larger number of responses provides greater confidence that the collected data can represent a population [30]. Moreover, a survey is suitable when data analysis techniques, such as factor analysis, demand a sufficient sample size [30]. Prior works support the use of a survey for quantitative analysis [21,29].

3.1.1. Semi-Structured Interviews

The survey development was supported by semi-structured interviews with 20 industry professionals. The interviews were deemed adequate because information on the challenges of EMP implementation is scarce. It allowed for detailed information to be obtained through communication with knowledgeable individuals in the field [27,29]. The target population for the interviews included professionals with experience in EMP implementation. These included officers in the Department of Environment, Department of Irrigation and Drainage (DID), and Public Works Department (PWD), as well as local councils, engineers, and environmental officers. The interview sessions lasted approximately 60 min. Before conducting the interviews, the background and objectives of the study were introduced to the interviewees. The key question during the interview was "What are the challenges to EMP implementation in Malaysia?" Follow-up questions were also asked to acquire more information. After the interview, a summary was sent to the interviewees for verification. The interviewee could check any misinformation or misinterpretation and recommend corrections if necessary. The data collected at this stage were then analyzed using thematic analysis. The respondent profiles of the interviewees are presented in Table 2.

Table 2. Respondent profile of the interviewees.

ID	Sector	Stakeholder	Position	Organization
1	Public	Law enforcer 1	City Council Engineer	City Council
2	Public	Law enforcer 2	Environmental Officer	Public Works Department
3	Public	Law enforcer 3	Environmental Officer	Public Works Department
4	Public	Law enforcer 4	DID Officer	Department of Irrigation and Drainage
5	Public	Law enforcer 5	DID Officer	Department of Irrigation and Drainage
6	Public	Law enforcer 6	DID Officer	Department of Irrigation and Drainage
7	Public	Law enforcer 7	Engineer	Department of Irrigation and Drainage
8	Private	Contractor 1	Environmental Officer	Contractor
9	Private	Contractor 2	Environmental Officer	Contractor
10	Private	Contractor 3	Environmental Officer	Contractor
11	Private	Contractor 4	Environmental Officer	Developer
12	Private	Contractor 5	Environmental Officer	Contractor
13	Private	Consultant 1	Hydrology Engineer	Hydrology Consultant
14	Public	Consultant 2	Environmental Officer	Consultant
15	Private	Consultant 3	Environmental Officer	Consultant
16	Private	Consultant 4	Environmental Officer	Consultant
17	Public	Engineer 1	PWD Engineer	Public Works Department
18	Private	Engineer 2	Hydrology Engineer	Hydrology Consultant
19	Private	Engineer 3	Site Engineer	Developer
20	Private	Engineer 4	Engineer	Contractor

Based on the results of the interviews, a thematic analysis was conducted to identify the challenges to EMP implementation. The analysis was performed based on the six phases in Ref. [31]. The first phase is immersion in the data, which includes reading and transcribing the data and noting ideas in the entire dataset. The second phase entails the generation of potential codes and the collection of data relevant to each code. The third phase includes searching for themes. This phase analyzes the codes and searches for a theme that combines the codes into a common theme. The fourth phase includes refining the identified themes by continually checking whether the themes represent the identified codes and identifying any emerging themes. The fifth phase entails naming a theme according to the data captured. The sixth phase includes reporting the output of the analysis process.

3.1.2. Systematic Literature Review

In addition to the semi-structured interviews, a systematic literature review (SLR) was conducted to support the survey development. An SLR is an efficient technique for assessing all available evidence on a specific topic. This approach allows scholars to search for sources beyond their subject areas and networks [32]. Therefore, the SLR was deemed adequate for capturing the challenges of EMP implementation. This study used the Scopus database during the SLR because (1) it is the most widely used search engine for conducting literature reviews [33,34]; (2) it covers a wide range of papers in different disciplines compared with other search engines and is a popular database engine for literature reviews in the construction management domain [34]. Publications including any of the following strings in a journal's title, abstract, and keywords were identified: ("environment" OR "environmental" OR "natural resources") AND ("law" OR "regulations" OR "act" OR "legislation" OR "regulation") AND ("construction management" OR "construction project" OR "construction projects" OR "construction industry"). The search process revealed 273 publications, of which 41 were relevant to the study topic. Finally, the results from the SLR and interviews were concurrently revised to obtain a comprehensive list of challenges to EMP implementation. The list of potential challenges to EMP implementation developed using the interviews and SLR is presented in Appendix A.

3.1.3. Survey Design

The survey comprised two parts. Part I included general information about the respondents, including types of organization, position, academic qualification, years of experience, and the number of projects involved. Part II asked the respondents to rate the importance of the challenges to EMP implementation based on a five-point Likert scale ranging from (1) not critical to (5) very critical. This study employed a five-point scale because it is a convenient judgment scale for respondents [35,36]. Free space at the end of the survey was also provided to include any challenges identified by the respondents. The survey was conducted in English to avoid any misinterpretation during the back-and-forth translation process.

3.1.4. Pilot Study

After drafting the survey, six experts (construction industry professionals and academics) with at least five years of experience were interviewed in a pilot study. The objective of the pilot study was to check the completeness and rationality of the survey [35,36]. The experts were asked to critically review the survey design and structure, including the language, the technical terms used, and any ambiguity that emerged during the survey development. The experts were also given the opportunity to add any challenges that were not captured by the SLR and remove irrelevant ones. Based on the recommendations, the survey was finalized. This step matches the literature and practice. The finalized survey is presented in Appendix B.

3.2. Data Collection

After finalizing the survey, this study continued by gathering data from construction industry professionals. The target population includes all construction industry professionals experienced in EMPs. As the sampling frame was not available, non-probability sampling was adopted by identifying individuals possessing knowledge and expertise in EMPs. This approach can be used when random sampling is difficult to achieve; participants can be selected based on their willingness to participate [29,37]. A purposeful snowball sampling approach was used to obtain a sufficient sample size. Initially, eligible construction industry professionals using EMPs were identified by the authors' networks and communications. Subsequently, they were asked to nominate any candidates appropriate to answer the survey based on their academic or industry experience. Reminders were sent to the target population to increase the response rate. The data collection commenced on 10 April 2020 and ended on 9 July 2020. A total of 102 valid responses were obtained.

While the sample size seems small, the central limit theorem holds when the sample size is larger than 30. Therefore, statistical analyses can still be conducted [38]. Table 3 displays the respondent profile for the survey data.

Table 3. Respondent profile for survey data.

Type of Distribution	Description	Frequency	(%)	Cumulative (%)
Type of organization	Contractors	21	20.59	20.59
	Owners	55	53.92	74.51
	Consultants	26	25.49	100.00
Title/position	Government Officer	14	13.73	13.73
	Engineer	27	26.47	40.20
	Environment Officer	59	57.84	98.04
	Project Manager	2	1.96	100.00
Academic qualification	Diploma	9	8.82	8.82
	Bachelor's Degree	67	65.69	74.51
	Master's Degree	24	23.53	98.04
	Doctoral Degree	2	1.96	100.00
Years of experience	<2 years	23	22.55	22.55
	2–5 years	36	35.29	57.84
	6–9 years	16	15.69	73.53
	>10 years	27	26.47	100.00
Number of projects	<2 projects	24	23.53	23.53
	2–5 projects	41	40.20	63.73
	6–9 projects	12	11.76	75.49
	>10 projects	25	24.51	100.00

3.3. Data Analysis

The Statistical Package for Social Sciences (SPSS) software was used to analyze quantitative data. These analyses included reliability testing using Cronbach's alpha coefficient, mean score, standard deviation, and normalization. Finally, exploratory factor analysis (EFA) was conducted to identify the underlying relationships between the main challenges in implementing an EMP at construction sites. Prior construction management works support the use of these techniques for ranking the variables and identifying their underlying relationships [29,39]. The data analyses are described in detail in the subsequent subsections.

3.3.1. Reliability Testing

Cronbach's alpha is one of the most popular methods for assessing scale reliability. In a survey, Cronbach's alpha established the average correlation or internal consistency between variables to evaluate the reliability of the survey. Cronbach's alpha coefficient α ranges from 0 to 1 and can describe the reliability of factors extracted from multipoint and/or dichotomous formatted scales or surveys [40]. A higher α value indicates good reliability in the measurement scales. The computed α value for 30 was 0.967, indicating that the measurement scale had high reliability at the 5% level of significance [41].

3.3.2. Ranking Analysis

After reliability testing, the mean score and standard deviation were computed to rank the challenges of the EMP implementation. If two or more challenges had equal mean scores, the challenge with the lowest standard deviation was ranked higher. Subsequently, the normalized value technique was employed to determine the main challenges among the 30 EMP implementation challenges. The main challenges were determined based on calculated normalized values. Only challenges with a normalized value ≥ 0.50 were identified as critical [39,42].

3.3.3. Exploratory Factor Analysis

The main challenges for implementing an EMP at construction sites identified earlier are subject to EFA. EFA is a statistical analysis technique that can group a large number of variables into a manageable set of factor groupings [30]. It is a powerful technique for identifying the underlying relations between many interrelated variables [29]. Principal axis factoring was selected as the extraction method to identify the underlying grouped factors because it yields more stable loadings than other factor extraction methods for EFA. During the analysis, the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity were used to examine the appropriateness of the FA. The acceptable KMO value (ranges from 0.00 to 1.00) should exceed 0.60. The value of Bartlett's test of sphericity determines whether the population correlation matrix is an identity matrix. Regarding the communalities, this study adopted a 0.40 cut-off value. A cut-off factor loading of 0.50 was used to eliminate the challenges that are weak indicators. Cronbach's α coefficient was then used to examine the internal consistency of the constructs. The closer the value to 1.00, the higher the internal consistency of the groupings [30].

3.3.4. Agreement Analysis

An ANOVA test was used to understand the differences in the respondents' perceptions of the main challenges in implementing an EMP at construction sites. ANOVA allows us to observe any significant differences in the mean scores between different groups, such as project stakeholders [43]. This test is adequate for the data analysis of Likert-scale questions and small sample size research. A p-value less than 0.05 indicates inconsistent views toward the challenges to EMP implementation by the survey respondents [43].

4. Results

4.1. Results for the Mean Ranking Analysis

Table 4 shows the rank of the challenges to EMP implementation in Malaysia, along with the standard deviation and normalized values. Of the 30 challenges, 21 had a normalized value greater than 0.05, representing the main challenges in implementing an EMP at construction sites.

4.2. Results for the Exploratory Factor Analysis

EFA was used to explore the underlying factor groupings of the 21 main challenges to EMP implementation. Prior works suggest a minimum ratio of two respondents for each challenge [44]. In addition, at least 50 samples are necessary to conduct EFA [45]. As the number of respondents is 102 and the number of challenges is 30, conducting EFA is appropriate. The result of Bartlett's test of sphericity is 465.762, with a significance value of less than 0.001, indicating that the correlation matrix is significant at $p < 0.05$ and thus is not an identity matrix [24]. The communality value for the challenges ranges between 0.513 and 0.735, which is above 0.40. Therefore, the data are suitable for EFA.

Table 5 and Figure 2 summarize the results of the EFA. Two components were retained, representing eight out of the 21 main challenges to the EMP. A cut-off factor loading of 0.50 was used to screen out items that are weak indicators of common factors. As a result, twelve main challenges were removed for not having factor loadings greater than 0.50. The two components explain approximately 69.767% of the total variance, which is more than the 60% required for adequate construct validity [46,47]. Cronbach's α reliability test was then run to ensure that the factors were appropriately grouped. Cronbach's α coefficients were 0.876 and 0.864, respectively. These values are greater than the required minimum of 0.60 [39]. Therefore, each construct possessed a good internal consistency.

Table 4. Results of the mean ranking analysis.

Code	Challenge	Mean	SD	NV	Rank
CH29	Contractors focus on work progress but not parallel with the EMP progression	3.86	1.161	1.000	1
CH24	Failure to maintain EMP facilities periodically	3.75	1.114	0.889	2
CH11	Lack of publicity through media about EMP	3.72	1.23	0.861	3
CH03	Influencing factors of the cost-reducing process of EMP implementation	3.70	0.91	0.843	4
CH23	Contractors perceived that the EMP work costs are overcharged	3.70	1.159	0.843	5
CH25	Did the EMP just for the report	3.65	1.302	0.796	6
CH28	Unexpected changes in on-site conditions	3.61	1.109	0.759	7
CH21	Inadequate incentive for EMP implementation	3.59	1.075	0.741	8
CH26	Proposed EMP design inappropriate for the site situation	3.58	1.173	0.731	9
CH30	Shortage of resources for EMP implementation	3.49	1.15	0.648	10
CH17	High cost of implementing EMP	3.48	1.088	0.639	11
CH04	Lack of understanding of the processes and workflows required for EMP implementation	3.44	1.02	0.602	12
CH10	Lack of awareness of EMP implementation	3.42	1.13	0.583	13
CH01	Lack of commitment	3.42	1.076	0.583	14
CH02	Lack of understanding of the roles and responsibilities of parties	3.41	1.056	0.574	15
CH16	Lack of knowledge about EMP	3.40	1.128	0.565	16
CH27	Incorrect installation of EMP components	3.38	1.169	0.546	17
CH05	Fragmented nature of organizations in the construction industry	3.38	0.912	0.546	18
CH14	Insufficient staffing to inspect EMP implementation	3.37	1.098	0.537	19
CH12	Lack of a comprehensive framework and implementation plan for EMP	3.37	1.089	0.537	20
CH09	Negative attitude towards EMP implementation	3.35	1.295	0.519	21

SD = standard deviation; NV = Normalized value = (mean–minimum mean)/(maximum mean–minimum mean).

Table 5. Results of the factor analysis.

Construct	Code	Challenges for Implementing an EMP in Construction Projects	Factor Loading	Eigenvalues	Variance Explained (%)	Cronbach's Alpha
People-related challenges	CH01	Lack of commitment	0.893	7.275	57.089	0.876
	CH02	Lack of understanding of the roles and responsibilities of parties	0.831			
	CH04	Lack of understanding of the processes and workflows required for EMP implementation	0.654			
Project-related challenges	CH17	High cost of implementing EMP	0.680	1.426	12.678	0.864
	CH23	Contractors perceived that the EMP work costs are overcharged	0.735			
	CH25	Did the EMP just for the report	0.682			
	CH28	Unexpected changes in on-site conditions	0.695			
	CH30	Shortage of resources	0.551			

4.3. Results of the Agreement Analysis

Table 6 and Figure 3 present the results of the agreement analysis of the main challenges between different project stakeholders, including owners, contractors, and consultants. The results show consistent views on the criticality of the following main challenges: CH17, CH28, and CH30. However, the criticalities were significantly different among project stakeholders for the following challenges: CH25, CH23, CH04, CH02, and CH01. These results indicate that most of the main challenges in EMP implementation are perceived differently by project stakeholders.

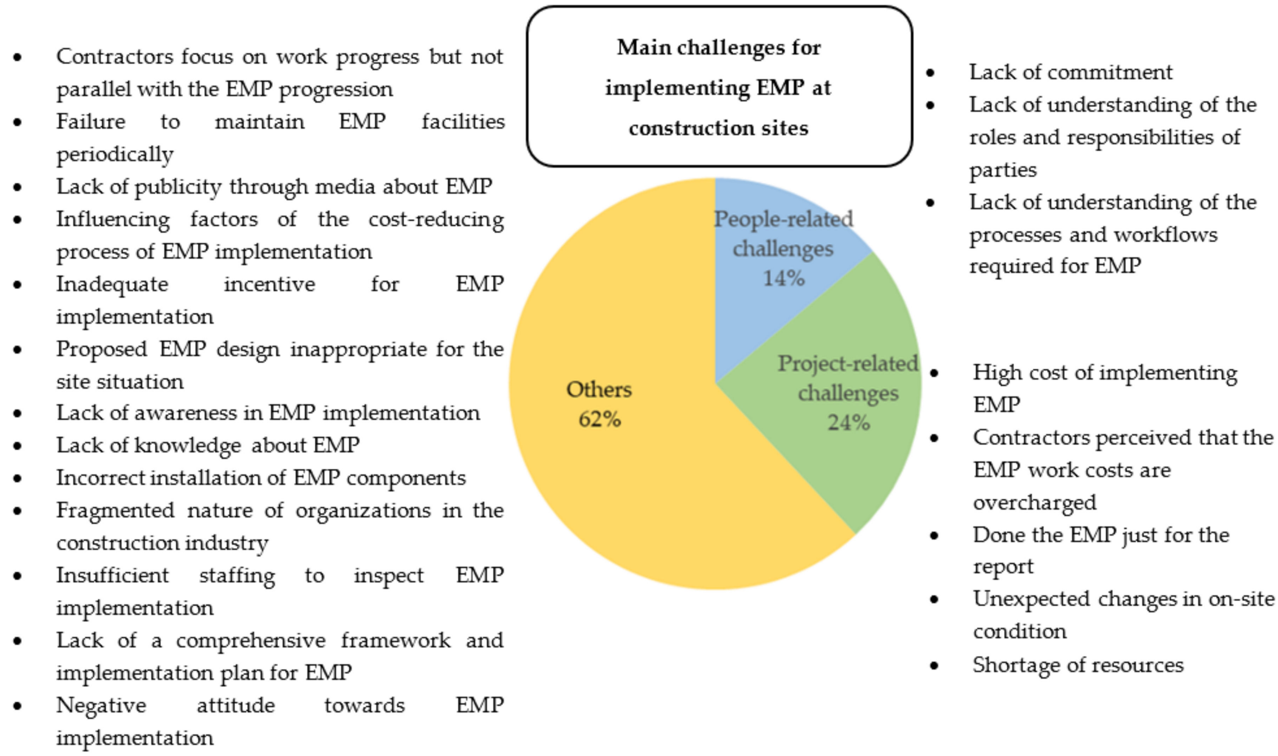

Figure 2. Percentage of each construct of the challenges to EMP implementation.

Table 6. Results of the agreement analysis.

Code	Challenge	Owners				Contractors				Consultants				α
		M	SD	NV	R	M	SD	NV	R	M	SD	NV	R	
CH09	Negative attitude towards EMP implementation	3.60	1.23	1	1	3.04	1.32	0.27	27	3.81	1.15	0.52	17	0.02 [a]
CH24	Failure to maintain EMP facilities	3.60	1.31	1	2	3.58	1.10	0.85	4	4.19	0.88	0.84	4	0.06
CH11	Lack of publicity through media about EMP	3.60	1.23	1	3	3.58	1.27	0.85	5	4.07	1.11	0.74	6	0.21
CH29	Contractors focus on work progress but not parallel with the EMP progression	3.55	1.32	0.96	4	3.73	1.22	1.00	1	4.37	0.69	1.00	1	0.02 [a]
CH03	Influencing factors of the cost-reducing process of EMP implementation	3.55	0.89	0.96	5	3.60	0.92	0.87	3	4.00	0.88	0.68	8	0.13
CH14	Insufficient staffing to inspect EMP implementation	3.50	1.19	0.92	6	3.11	1.01	0.35	23	3.81	1.08	0.52	16	0.02 [a]
CH25	Did the EMP just for the report	3.50	1.32	0.92	7	3.38	1.38	0.64	12	4.30	0.87	0.94	2	0.01 [a]
CH26	Proposed EMP design inappropriate for the site situation	3.45	1.19	0.89	8	3.55	1.20	0.81	8	3.74	1.13	0.45	18	0.67
CH23	Contractors perceived that the EMP work costs are overcharged	3.45	1.05	0.89	9	3.53	1.23	0.79	9	4.22	0.93	0.87	3	0.02 [a]
CH04	Lack of understanding of the processes and workflows required for EMP implementation	3.45	0.89	0.89	10	3.18	1.06	0.42	16	3.96	0.85	0.65	9	0.00 [a]
CH17	High cost of implementing EMP	3.40	1.05	0.85	11	3.45	1.12	0.71	10	3.59	1.08	0.32	21	0.81
CH10	Lack of awareness of EMP implementation	3.40	1.10	0.85	12	3.18	1.11	0.42	17	3.93	1.07	0.61	12	0.02 [a]
CH28	Unexpected changes in on-site condition	3.30	1.13	0.77	14	3.65	1.16	0.92	2	3.74	0.98	0.45	19	0.37
CH27	Incorrect installation of EMP components	3.30	1.08	0.77	15	3.13	1.17	0.37	22	3.96	1.06	0.65	10	0.01 [a]
CH01	Lack of commitment	3.30	0.92	0.77	17	3.15	1.08	0.39	21	4.07	0.92	0.74	5	0.00 [a]
CH21	Inadequate incentive for EMP implementation	3.25	1.12	0.73	18	3.55	1.10	0.81	7	3.93	0.92	0.61	11	0.09
CH16	Lack of knowledge about EMP	3.25	1.21	0.73	19	3.15	1.11	0.39	20	4.04	0.85	0.71	7	0.00 [a]
CH05	Fragmented nature of organizations in the construction industry	3.25	0.85	0.73	20	3.18	0.88	0.42	15	3.89	0.85	0.58	14	0.00 [a]
CH30	Shortage of resources for EMP implementation	3.20	1.15	0.69	21	3.55	1.18	0.81	6	3.59	1.08	0.32	22	0.45
CH02	Lack of understanding of the roles and responsibilities of parties	3.20	1.06	0.69	24	3.24	1.05	0.48	13	3.93	0.92	0.61	13	0.01 [a]
CH12	Lack of a comprehensive framework and implementation plan for EMP	3.15	1.09	0.65	26	3.38	1.06	0.64	11	3.52	1.16	0.26	25	0.52

M = mean; SD = standard deviation; normalized value (NV) = (mean–minimum mean)/(maximum mean–minimum mean); R = rank; α (ANOVA) result is insignificant at the 0.05 significance level (sig. > 0.05).

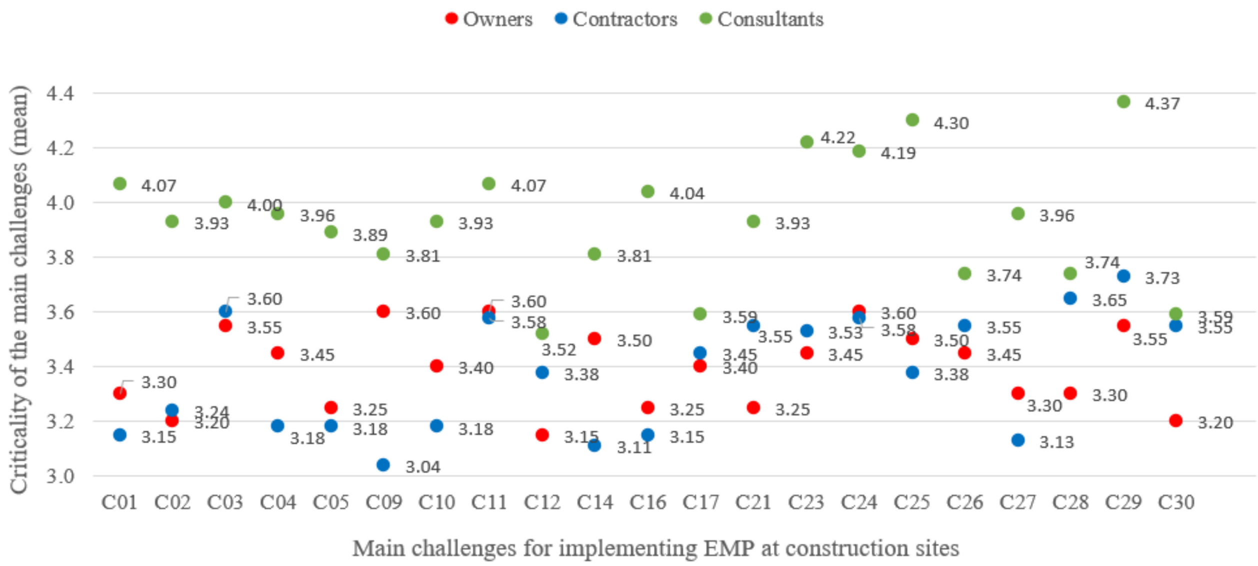

Figure 3. Agreement analysis between stakeholders. CH01 = Lack of commitment; CH02 = Lack of understanding of the roles and responsibilities of parties; CH03 = Influencing factors of the cost-reducing process of EMP implementation; CH04 = Lack of understanding of the processes and workflows required for EMP implementation; CH05 = Fragmented nature of organizations in the construction industry; CH09 = Negative attitude towards EMP implementation; CH10 = Lack of awareness of EMP implementation; CH11 = Lack of publicity through media about EMP; CH12 = Lack of a comprehensive framework and implementation plan for EMP; CH14 = Insufficient staffing to inspect EMP implementation; CH16 = Lack of knowledge about EMP; CH17 = High cost of implementing EMP; CH21 = Inadequate incentive for EMP implementation; CH23 = Contractors perceived that the EMP work costs are overcharged; CH24 = Failure to maintain EMP facilities; CH25 = Did the EMP just for the report; CH26 = Proposed EMP design inappropriate for the site situation; CH27 = Incorrect installation of EMP components; CH28 = Unexpected changes in on-site condition; CH29 = The contractor focuses on work progress but not parallel with the EMP progression; CH30 = Shortage of resources for EMP implementation.

5. Discussion

5.1. Component 1: People-Related Challenges

Although acknowledging the need for more sustainable construction has emerged globally, understanding and awareness of environmental protection and the implementation of related policies are still low [17]. Poor environmental awareness discourages project stakeholders from achieving environmental protection. Raising environmental awareness has the potential to disclose the pollution damage caused by the construction industry [21,23]. This approach is achievable through running awareness campaigns through the media [24]. Although governments can play an important role in running these campaigns and providing training programs, significant responsibility is attributed to project stakeholders. These stakeholders give more weight to traditional project objectives, such as time, cost, and quality, as success measures of construction work than environmental impact reduction. Thus, project stakeholders consider environmental performance as an emerging project objective, and the attitude towards sustainable practices is negative [18]. Furthermore, the construction industry is fragmented. Project stakeholders are obliged to work under regulatory constraints. The success of environmental protection lies in delineating the roles, responsibilities, and commitments of all project stakeholders [14]. Therefore, greater success in achieving sustainable practices can only be achieved with positive attitudes and commitments among project stakeholders.

5.2. Component 2: Project-Related Challenges

Project stakeholders naturally seek savings in construction projects and avoid potential uncertainties that affect business returns [42,48]. Because of the extra cost incurred and the required financial resources, EMPs are poorly implemented. While the client is more interested and willing to invest in environmental management, contractors are not motivated. In particular, contractors are reluctant to invest in environmental management because of increased operating costs [20]. This resonates with prior works illustrating that not all contractors in Malaysia are willing to pay for improved construction waste management [17,21]. Because of its large capital, large contractors are more willing to invest in environmental sustainability than medium-sized and small contractors. This highlights the difference in contractor grade and company size in participating in environmental protection. Although this finding does not directly reflect contractors' attitudes toward EMP implementation, it indicates an unwillingness to participate in environmental protection. Furthermore, EMP implementation requires skilled labor, heavy machinery, and advanced materials. This results in increased on-site operations, which are unfavorable for contractors because of the additional resources required [20,42,49]. Therefore, they implement EMPs to meet only the minimum requirements for environmental protection control [23].

6. Implication

This study overcomes the limitations of the existing body of knowledge by focusing on the challenges for implementing EMPs in Malaysia. It reveals the major challenges affecting EMP implementation and their underlying relationships. This study provides a profound understanding of the nature of people- and project-related challenges that represent a latent construct contributing to EMP implementation in Malaysia. This construct should assist scholars and academicians in proposing solutions for effective EMP implementation in the construction industry in Malaysia. The study findings benefit the construction industry and AEC professionals by prioritizing resources to address the identified critical challenges. By categorizing the challenges, the government and policymakers are informed about the major shortfall areas that should be addressed to enhance EMP implementation in the construction industry in Malaysia. As contractors naturally pursue profit, policymakers play a critical role in providing financial incentives and facilitation for contractors to diminish their reluctance to implement EMP. Through this initiative, policymakers can ensure that EMPs are effectively implemented, especially in construction organizations with limited financial capital.

7. Conclusions

To minimize the impact of construction activities on the environment, we identified the main challenges in EMP implementation. Using an SLR and semi-structured interviews, 30 potential challenges to EMP implementation were identified. The normalized value technique was used to distinguish the main challenges suitable for subsequent analysis. EFA was then used to group the main challenges that had common features. Finally, an ANOVA test was performed to observe any significant differences in the opinions on the main challenges identified in FA.

The results demonstrate that 21 challenges in EMP implementation are critical. Out of those, eight main challenges were retained using EFA:

- Lack of commitment
- Lack of understanding of the roles and responsibilities of parties
- Lack of understanding of the processes and workflows required for EMP implementation
- High cost of implementing EMP
- Contractors perceived that the EMP work costs are overcharged
- Did the EMP just for the report
- Unexpected changes in on-site condition
- Shortage of resources for EMP implementation

The eight main challenges can be grouped into two major components: people-related challenges and project-related challenges. These two components should be addressed to promote EMP implementation. The results demonstrate the need for a balanced allocation of commitments and responsibilities among all project stakeholders. The government can deploy initiatives contributing to effective EMP implementation. This can be done by providing instructions and guidelines to help project stakeholders understand and implement EMP effectively. Moreover, it is important to provide financial facilities, especially for contractors, to cover the costs incurred by using additional materials, machinery, and labor on the construction site.

This study contributes to the environmental management body of knowledge by providing a profound understanding of the challenges to EMP implementation. Scholars can benefit from the study findings by focusing on the latent construct and formulating strategies to overcome these challenges. Project stakeholders, especially contractors, can commit resources to this study construct because the challenges are competing for limited resources; that is, they can avoid any extra costs.

However, there are some limitations worth stating. This study used the SLR approach as a foundation to capture any challenges to EMP implementation mentioned in prior works. Considering socio-technical, institutional, and organizational theories can be a future research direction. In addition, this study did not differentiate between different types of projects, such as commercial and public projects. Future research can focus on a specific type of project to better understand the challenges. A comparative analysis between different types of projects can also provide meaningful findings and common areas that should be improved. Finally, the data were primarily interpreted within the context of Malaysia. The findings are very much tied to the local context, and other main challenges might be faced in different countries, including a lack of clear government policies and poor client demand. Therefore, the results should be applied to other countries with caution and appropriate adjustments. A wider scope of data collection across different countries and regions can provide opportunities to comprehensively contrast the challenges, providing insights on causes and countermeasures. Nevertheless, this study provides a profound understanding of the challenges in EMP implementation for scholars and the construction industry in Malaysia.

Author Contributions: Conceptualization, A.S.A., R.A.R. and S.W.A.; methodology, A.S.A., R.A.R. and S.W.A.; validation, R.A.R., S.W.A. and S.A.; formal analysis, A.S.A.; investigation, A.S.A.; resources, A.S.A., R.A.R., S.W.A. and S.A.; data curation, A.S.A.; writing—original draft preparation, A.S.A.; writing—review and editing, M.S.A.-M., R.A.R., S.W.A. and S.A.; visualization, A.S.A.; supervision, R.A.R. and S.W.A.; project administration, R.A.R. and S.W.A.; funding acquisition, R.A.R. and S.W.A. All authors have read and agreed to the published version of the manuscript.

Funding: This study was funded by Universiti Malaysia Pahang, through the Fundamental Research Grant Scheme (grant number: RDU190382). The publication fee was funded by the Deanship of Scientific Research, Qassim University.

Institutional Review Board Statement: Ethical review and approval were waived for this study, due to the study involving anonymous data collection.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to some data being proprietary or confidential in nature. Therefore, the data may only be provided with restrictions (e.g., anonymized data).

Acknowledgments: The researchers would like to thank the Deanship of Scientific Research, Qassim University, for funding the publication of this study. The authors are also grateful to the editors and the anonymous reviewers for their insightful comments, which helped improve this paper's quality. Finally, this paper forms part of a larger research project aimed at promoting environmental management plan implementation within a developing country, Malaysia, and therefore the authors

acknowledge that this paper shares a similar background and methodology with other related papers published by the authors, but with different scopes and objectives.

Conflicts of Interest: The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

Appendix A. Challenges Identified from the Interviews and Systematic Literature Review

Code	Challenge	Source	Interview
CH01	Lack of commitment (e.g., owner's commitment, contractor's commitment)	[1,12,14,16,17,50]	✓
CH02	Lack of understanding of the roles and responsibilities of parties	[1,12,14,16,17,50]	✓
CH03	Influencing factors of the cost-reducing process of EMP implementation	[8,12]	✓
CH04	Lack of understanding of the processes and workflows required for EMP implementation	[8,12]	✓
CH05	Fragmented nature of organizations in the construction industry	[15,51]	✓
CH06	Absence of industry standards for EMP	[15]	✓
CH07	Individual practitioners neglected to consider their belief systems and impact of policy decisions in implementing EMP	[5,11,12,17,49]	✓
CH08	Decision makers not seeking professional advisors	[5,15]	✓
CH09	Negative attitude towards EMP implementation	[4–6,13,24,50,52]	✓
CH10	Lack of awareness of EMP implementation	[1,4,5,17,24,27,51]	✓
CH11	Lack of publicity through media about EMP	[4,5,24,52]	✓
CH12	Lack of a comprehensive framework and implementation plan for EMP	[3]	✓
CH13	Lack of comprehensive rules and regulations	[3]	✓
CH14	Insufficient staffing to inspect EMP implementation	[3]	✓
CH15	Inefficiency in EMP inspection procedures	[6,19]	-
CH16	Lack of knowledge about EMP	[17,19]	✓
CH17	High cost of implementing EMP	[6,11,12,19,52]	✓
CH18	Corruption in the process of EMP implementation	[14]	✓
CH19	Lack of competitive advantage from EMP implementation	[14]	✓
CH20	Shortage of qualified personnel	[14]	✓
CH21	Inadequate incentive for EMP implementation	[12,14,16,17,52]	✓
CH22	Miscommunication between team members	[14]	✓
CH23	Contractors perceived that the EMP work costs are overcharged	[4–6,12,28]	✓
CH24	Failure to maintain EMP facilities	[24]	✓
CH25	Did the EMP just for the report	[16]	✓
CH26	Proposed EMP design inappropriate for the site situation	[16]	-
CH27	Incorrect installation of EMP components	[17,49]	-
CH28	Unexpected changes in on-site conditions	[6]	✓
CH29	The contractor focused on work progress but not parallel with the EMP progression	[6]	-
CH30	Shortage of resources (e.g., workforce, material, machinery) for EMP implementation	-	✓

Appendix B. The Survey

Challenges for Implementing Environmental Management Plan (EMP) in Malaysia.
Section A: Respondent profile
Please provide the following information.
Your type of organization:

1. Owners (e.g., government, developers)
2. Consultants
3. Contractors
4. Others: ____________

Please state your title/position: ________________
Your highest academic qualification:

1. High School Certification
2. Diploma
3. Bachelor's Degree
4. Master's Degree
5. Doctoral Degree

Your years of experience in the construction industry:

1. Less than 2 years
2. 2–5 years
3. 6–9 years
4. More than 10 years

Your years of experience related to the implementation of EMP:

1. Less than 2 years
2. 2–5 years
3. 6–9 years
4. More than 10 years

Number of projects related to the implementation of EMP:

1. Less than 2 projects
2. 2–5 projects
3. 6–9 projects
4. More than 10 projects

Most of your projects are located at:

1. Northern Region (Perlis, Kedah, Penang, Perak)
2. East Coast Region (Kelantan, Terengganu, Pahang)
3. Central Region (Selangor, Kuala Lumpur, Putrajaya)
4. Southern Region (Negeri Sembilan, Melaka, Johor)
5. East Malaysia (Sabah, Sarawak, Labuan)

Section B: Challenges for Implementing Environmental Management Plan (EMP) in Malaysia.

Part 1: Please rate the criticality of the following challenges in the implementation of environmental management plan (EMP) in Malaysian construction projects.

Challenge (In Random Order Using Online Survey Platform)	Criticality				
Lack of commitment (e.g., owner's commitment, contractor's commitment)	Not Critical	Slightly Critical	Moderately Critical	Critical	Very Critical
...	Not Critical	Slightly Critical	Moderately Critical	Critical	Very Critical
...	Not Critical	Slightly Critical	Moderately Critical	Critical	Very Critical
...	Not Critical	Slightly Critical	Moderately Critical	Critical	Very Critical
...	Not Critical	Slightly Critical	Moderately Critical	Critical	Very Critical
...	Not Critical	Slightly Critical	Moderately Critical	Critical	Very Critical
...	Not Critical	Slightly Critical	Moderately Critical	Critical	Very Critical
...	Not Critical	Slightly Critical	Moderately Critical	Critical	Very Critical
...	Not Critical	Slightly Critical	Moderately Critical	Critical	Very Critical
Shortage of resources (e.g., workforce, material, machinery) for EMP implementation	Not Critical	Slightly Critical	Moderately Critical	Critical	Very Critical

Part 2: Please indicate and rate any additional challenges in the implementation of environmental management plan (EMP) in Malaysian construction projects.

Additional Challenge	Criticality				
	Not Critical	Slightly Critical	Moderately Critical	Critical	Very Critical
	Not Critical	Slightly Critical	Moderately Critical	Critical	Very Critical
	Not Critical	Slightly Critical	Moderately Critical	Critical	Very Critical

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