

Article

How Different Stakeholders Perceive Benefits, Challenges, and Barriers in the Implementation of Green Technology Projects

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Abstract

Differing stakeholder interests often lead to the application of varying criteria when evaluating green technology projects. This heterogeneity can impede project outcomes by making it challenging to reconcile conflicting perspectives. The present study empirically examines stakeholder alignment in relation to the perceived benefits and barriers to green technology implementation. Insights from a focus group comprising 15 project stakeholders were used to identify key barriers, which were subsequently ranked using survey data collected from 286 UAE-based stakeholders. A customised *fuzzy*-based Failure Mode and Effects Analysis tool (FMEA–FST) was applied to prioritise these factors. The results reveal significant variation in the salience of factors across stakeholder groups, highlighting both notable differences and shared framing biases. The study's originality lies in its use of the bespoke FMEA–FST model to prioritise factors, thereby identifying the relative importance of benefits, barriers, and challenges. Notably, '*Lack of support from senior management*' emerged as the most critical factor across all categories, while '*Potentially lower benefits for small or less complex projects*' was deemed the least important. To foster greater stakeholder alignment, the study recommends strengthening social relationships to bridge divergent perspectives. Limitations include the inability to account for changes in factor salience across different stages of the project lifecycle, as well as the exclusion of temporal and typological effects. These limitations present opportunities for future research.

Keywords: stakeholder theory; stakeholder management; stakeholder congruence; project management; green technology implementation



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1. Introduction

Since Cleland [1], project-focused research has widely recognised that stakeholders play a critical role in determining project outcomes. Consequently, stakeholder management and the alignment of their expectations have become central to project success,

including projects with substantial green technology components [2,3]. Numerous studies on project success factors consistently highlight the importance of both internal and external stakeholders [4]. Alongside factors such as top management support [5,6], client acceptance [7,8], team member contributions [8], and community involvement [9,10], stakeholder management has also been identified as a critical success factor in green technology projects [11,12].

The core aim of project stakeholder management is to harmonise diverse expectations and interests, which are often shaped by socially constructed perspectives [13,14]. Stakeholder heterogeneity generates varied interests, leading different groups to apply different criteria when evaluating the performance of green projects [13–15].

The implementation of green technology provides significant benefits across multiple dimensions, including waste reduction and sustainability [16], market share growth or retention [17,18], and enhanced client satisfaction [8]. However, it also faces substantial *challenges* (i.e., structural obstacles that impede implementation) and *barriers* (i.e., tasks requiring skill and effort to overcome, while simultaneously offering learning opportunities).

Although the literature on green technology is extensive (e.g., [19–22]), it remains underdeveloped in explaining how different stakeholder groups define and prioritise performance, particularly in relation to the benefits, challenges, and barriers associated with green technology implementation. This gap is significant, as it limits efforts to reconcile stakeholder interests, thereby undermining trust, coordination, and communication within projects. Misalignment of stakeholder expectations is frequently cited as a major contributor to project failure [4,13,23–25].

Given the considerable impact of stakeholder heterogeneity and incongruence on green technology project performance [26–30], the specific purpose of this study is to empirically examine and prioritise, paying particular attention to stakeholder differences (i.e., heterogeneity), the *benefits*, *challenges*, and *barrier* factors that green technology project stakeholders consider most important during project implementation. To this end, the study presents two research questions:

RQ1: *What benefits, challenges, and barriers do stakeholders consider important during the implementation of green technology projects?*

RQ2: *What differences exist in how stakeholders prioritise these benefits, challenges, and barriers according to their roles in green technology projects?*

The remainder of this paper is structured as follows. Section 2 reviews the relevant literature. Section 3 outlines the research methodology, including the study’s evaluative Failure Mode and Effects Analysis (FMEA) tool. Section 4 prioritises the identified factors using a bespoke *fuzzy*-based approach (FMEA–FST). Section 5 presents the findings, which reveal substantial variation in the salience of factors across stakeholders, highlighting both notable differences and shared framing biases. Notably, ‘*Lack of support from senior management*’ emerges as the most critical benefit, barrier, and challenge for green technology project implementation, while ‘*Potentially lower benefits for small or less complex projects*’ is considered the least important. Section 6 discusses these findings, and Section 7 concludes the paper.

The study’s novelty lies in the prioritisation of factors achieved through the bespoke FMEA–FST model, which provides a structured and empirical approach to understanding stakeholder perceptions in green technology projects. A key feature of the FMEA model is the prioritisation of factors based on their likelihood, severity, and detection, with the resulting priority expressed as a Risk Priority Number (RPN) ranging from low to extreme. Although widely adopted in academic literature, conventional FMEA has several limitations (e.g., RPN similarity and the non-consideration of factor interdependence),

creating an opportunity for its enhancement through *fuzzification* via the application of Fuzzy Set Theory (FST). To date, the authors are not aware of any studies that have applied a fuzzy-based FMEA to examine factor salience among stakeholders in relation to the benefits, challenges, and barriers of green technology implementation.

2. Literature Review

2.1. Green Projects and Stakeholder Heterogeneity

A green technology project refers to an initiative that employs advanced technologies to protect the environment and mitigate the adverse effects of human activities on both nature and society. Such projects aim to conserve resources, minimise pollution, and reduce greenhouse gas emissions. Green technology initiatives encompass a broad range of activities, practices, products, and services that integrate sustainability objectives across multiple sectors, including renewable energy, energy efficiency, sustainable construction, and waste reduction [31].

Green projects typically involve diverse project teams [32,33] and multiple stakeholders [33,34], whose influence can shape critical decisions regarding green performance [35], commitment and de-escalation [36], product reuse [37], and benchmarking [38]. Freeman's [39] seminal stakeholder theory emphasises that projects inherently involve stakeholders, each with potential claims or interests in the project and its activities [40–42]. Freeman [39] defines 'stakeholders' as "...any group or individual who can affect or is affected by the achievement of the organisation's objectives" (p. 46). Accordingly, stakeholders may include any party directly involved in project implementation or indirectly affected by it [28–30,42]. This may include project team members, the project sponsor, government or regulatory bodies, contractors, local communities, and others likely to benefit from the project [43]. Project team members themselves may encompass a range of roles, including that of the project manager [44].

The implementation of green technology initiatives is a complex undertaking involving multiple project stakeholders whose interests play a critical role in determining project performance [13,24,45,46]. As a result, stakeholder management has been extensively studied in relation to project performance, including within green project contexts [33,47]. A consistent finding across these studies is that the success of green innovations is largely contingent on how effectively projects address key implementation benefits, challenges, and barriers. Because individual stakeholders often hold differing interests and priorities, their perceptions of project outcomes can vary significantly.

The literature underscores the importance of carefully evaluating stakeholder heterogeneity (i.e., differences in interests, expectations, and priorities) when assessing project outcomes [13,24,48]. Stakeholders are central to legitimising green projects by communicating and prioritising requirements [49,50]. Beyond their operational and production roles, stakeholders also contribute to organisational value through advisory and advocacy activities [28–30,36,51].

2.2. Stakeholder Incongruence in Green Projects

Due to their inherent complexity, decision-making in green projects typically requires the active involvement of both project teams and stakeholders. It is therefore essential to understand the salience of factors associated with their heterogeneity. In this context, salience denotes the degree to which any advantage, obstacle, or hindrance to the execution of green technology initiatives is perceived as significant by a particular stakeholder, as indicated by its relevance [43].

Heterogeneity (i.e., differences among individuals) affects the degree of congruence, or agreement, in how project team members and stakeholders perceive project outcomes.

Perceptions represent how individuals interpret and make sense of both personal experiences and socially constructed realities within projects [24].

Perceptual incongruence often emerges because different team members and stakeholders focus on distinct parameters of project outcomes [13,24,52]. It may also stem from demographic differences beyond role, age, and gender [13,53], extending to broader factors such as national culture [54,55]. Failure to recognise or address incongruence can adversely affect projects, making them vulnerable to risks such as miscommunication [33] and goal orientation conflicts, both of which undermine project outcomes [56].

Research suggests that practitioners who are aware of how colleagues perceive and prioritise different project imperatives, such as the benefits, challenges, and barriers associated with implementation, are more likely to foster collaborative and constructive working relationships [13,24]. While it is improbable that most, let alone all, stakeholders will share identical perceptions of a project at any given time, negotiation remains central to addressing diverse interests and expectations [24]. Under these circumstances, maintaining cordial relationships between project team members and stakeholders becomes critical, as it reduces the potential for conflict arising from their actions and decisions.

Given the well-documented link between team and stakeholder congruence and successful project outcomes [57], examining stakeholder heterogeneity, and how it shapes the prioritisation of perceived benefits, challenges, and barriers, provides valuable insights for both scholars and practitioners engaged in green technology projects.

2.3. Stakeholder Heterogeneity, Incongruence and Prioritization

Stakeholders in green technology projects are characterised by both heterogeneity (i.e., differences among individuals or groups) and incongruence (i.e., varying perceptions of the importance of benefits, challenges, and barriers in implementing green technology projects). These characteristics suggest that stakeholder groups, defined by their project roles, are unlikely to share identical views on how to prioritise benefits, challenges, and barriers during project execution [23,58,59]. Prioritising individual benefits, challenges, and barriers is particularly important given resource constraints. Consequently, projects often cannot devote equal attention to all relevant factors, and resource allocation is typically guided by perceived priority [60,61].

The principle underlying stakeholder prioritisation is that an individual's or group's interests determine which factors receive greater emphasis. In the context of this study, prioritisation encourages stakeholders to commit more resources to specific benefits, challenges, and barriers while simultaneously reducing attention to factors considered lower priority [43]. Therefore, effective prioritisation of benefits, challenges, and barriers is expected to increase the likelihood of successful green technology project implementation.

Project stakeholders may be either homogeneous or heterogeneous. Those performing similar roles (homogeneous stakeholders) are likely to have aligned perceptions of benefits, challenges, and barriers because they typically receive comparable information, thereby reducing information asymmetry. Conversely, stakeholders in different roles (heterogeneous stakeholders) are more likely to hold divergent perceptions due to variations in the information available to them. Accordingly, team members with similar roles are expected to share comparable priorities.

The interplay of stakeholder heterogeneity, incongruence, and prioritisation underscores the importance of collaboration. Collaboration ensures that, despite differences, a shared understanding of priorities can be developed and maintained. Crucially, such a collaborative approach helps to minimise or prevent conflicts among project team members, thereby safeguarding overall project performance.

3. Methods

3.1. Overview

To investigate how various stakeholders perceive the benefits, challenges, and barriers associated with the implementation of green technology projects, a mixed-methods research design was employed. Mixed methods integrate quantitative and qualitative approaches to provide a more comprehensive understanding of complex research problems [62–65]. This approach has become increasingly common in project management research due to its capacity to generate detailed insights into multifaceted, project-oriented issues [66].

The research process comprised two primary stages. In the first stage, a focus group session with experts was conducted to identify the key *benefits*, *barriers*, and *challenges* associated with implementing green technology projects. In the second stage, these factors were evaluated through questionnaire surveys administered to project management practitioners and stakeholders, enabling the assessment of their relative importance and influence. Overall, the study followed a three-phase structure encompassing data collection, data analysis, and presentation of results.

The empirical context for the research was an electronic payments (*epayments*) initiative in the United Arab Emirates (UAE). Although the project sponsor's primary objective was digital transformation, aimed at enhancing efficiency and service delivery through digital technologies, the initiative also yielded environmental benefits. By replacing paper invoicing with electronic payment systems, the project reduced emissions, conserved resources, and contributed to broader sustainability objectives.

Figure 1 illustrates the research process adopted in this study, comprising three phases: data collection, data analysis and processing, and presentation of results.

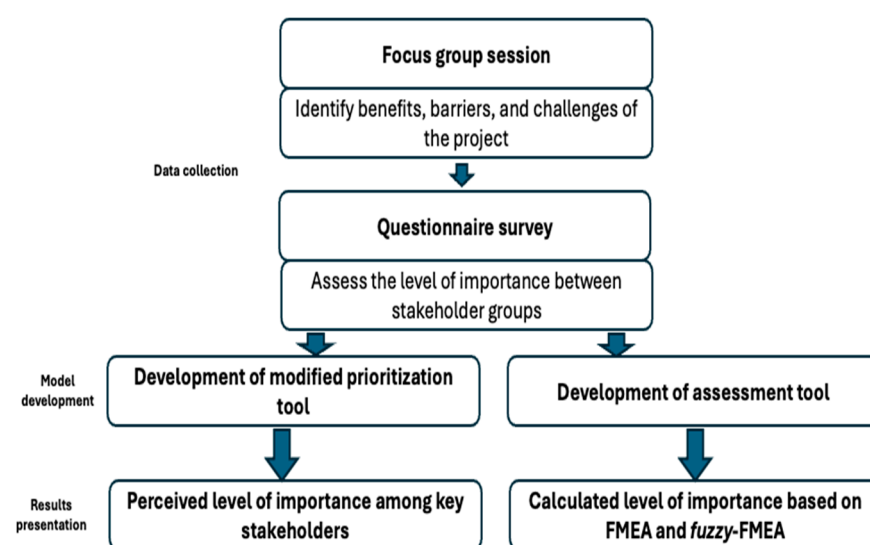


Figure 1. Research process.

3.2. Focus Group Session

A key consideration in the use of focus groups is the number of participants. Prior research suggests that, to competently identify a range of new issues, focus groups should comprise a minimum of three members [67], although Hennink et al. [68] report instances involving up to 40 participants. For optimal effectiveness, scholars generally recommend between six [69] and fifteen participants [70,71]. In line with these recommendations, the present study commenced with a focus group session involving fifteen project management practitioners experienced in digital transformation initiatives.

The discussion sessions included seven solution architects with between sixteen and twenty-five years of professional experience, most of whom were primarily engaged

in designing eco-friendly features for new *epayments* system projects. A judgemental (authoritative) sampling strategy, a non-probability method, was employed to recruit participants. This approach enabled the researcher to directly contact recognised experts in the field, making it particularly appropriate for identifying the benefits, barriers, and challenges associated with implementing the *epayments* service project [62,72].

Data from the focus group were analysed manually using content analysis, a method employed to extract key themes and generate valid inferences from verbal, written, or other forms of communication in both qualitative and quantitative contexts [73]. The analysis systematically identified and organised the main factors emerging from the discussions.

All sessions were conducted in Arabic and recorded to ensure accuracy. The recordings were subsequently reviewed and independently cross-checked to verify data consistency and reliability. During the translation process from Arabic to English, the researcher adhered to grammatical, idiomatic, and syntactical equivalence, following established procedures [74].

3.3. Survey

The survey was originally developed in English, piloted, refined, and subsequently translated into Arabic using standard translation and back-translation procedures (e.g., [74]). Participants were recruited through professional networks, targeting individuals involved in digital transformation projects across the UAE. A non-random purposive sampling approach was employed, supplemented by a snowballing strategy that encouraged respondents to share the survey with other relevant practitioners.

Data were collected over a four-month period in 2023, with periodic monitoring to ensure a sufficient number of responses. A target of more than 200 participants was set to enhance both validity and diversity. The questionnaire comprised two sections.

The first section gathered background information, including sector, project role, education, and work experience.

For stakeholder classification, a role-based framework was adopted, distinguishing between solution architects, project managers, and contractors. This framework was selected because it reflects the functional responsibilities most relevant to the delivery of green technology projects. These three groups represent the principal actors shaping both technical implementation and managerial outcomes.

Unlike demographic or interest-based classifications, which may capture broad differences but lack operational relevance, this role-based approach aligns with the organisational realities of green projects, where technological expertise, managerial oversight, and contractual execution intersect. Employing this classification ensured that stakeholder heterogeneity was captured in a manner that directly informed the evaluation of sustainability-oriented initiatives.

The second section assessed participants' perceptions of project benefits, barriers, and challenges using a five-point Likert scale. Data were analysed using SPSS (v.26.0). To ensure consistency between the qualitative and quantitative findings, survey items were carefully aligned with insights generated from the focus group discussions.

3.4. Modified Prioritisation Tool

Prioritisation involves ranking items or factors by importance, thereby reducing the risk of misallocating project resources and clarifying key outcomes for stakeholders [75]. In digitalisation projects, such as the *epayments* initiative, attention must be directed towards the most significant benefits at each stage. These priorities often differ among stakeholders; for example, benefits emphasised during the feasibility phase may not align with those considered critical during implementation.

The survey instrument was designed to capture variations in expert opinions based on education and professional experience. For instance, the assessment of a solution architect or systems integrator with more than twenty years of experience and a doctoral qualification was assigned greater weight than that of a practitioner with fewer than ten years of experience and a bachelor's degree.

This approach aligns with earlier studies emphasising the importance of both educational attainment and accumulated professional expertise in enhancing the reliability of expert judgment in project evaluation [6,76]. Research in project management and risk assessment has consistently shown that respondents with advanced qualifications or extensive professional experience tend to provide more consistent and reliable evaluations. Accordingly, modest incremental weights were applied to education (Table 1) and work experience (Table 2). These increments were designed to proportionally reflect higher levels of expertise while ensuring that no single subgroup dominated the results. This weighting strategy follows established practices in multi-criteria decision-making (MCDM) and risk assessment, where stakeholder heterogeneity is accounted for to balance knowledge depth and representativeness.

Table 1. Stakeholder's weight based on their educational background level.

Educational Background Level	Assigned Weight
BSc degree	1
MSc degree	1.25
PhD degree	1.5

Table 2. Stakeholder's weight based on their years of experience category.

Years of Experience	Assigned Weight
1–5 years	1
6–15 years	1.25
16–25 years	1.5
25 years	1.75

Weighting factors for education (Table 1) and experience (Table 2) were incorporated into the prioritisation model. The project benefits prioritisation equation, adapted from Chen et al. [61], was subsequently modified (Equation (1)) to assign weighted scores to the benefits identified through the focus group discussions.

$$S_b = \sum_{d=1}^5 \left(\frac{w_d L_d E_d Y_d}{N} \right) \quad (1)$$

where

S_b is the Perception Score (PS) of the variable b (*epayments* benefit);

d is the number of stakeholder's type (e.g., solution architect, project manager, and primary contractor), and $I \in [1, 5]$ in this investigation;

W_d is the stakeholder's (d) rating weight;

L_d is the perception of stakeholder (d), and is calculated by the proportion of positive responses to the variable (k) among stakeholder (d);

E_d is the weight of stakeholder (d) educational background level based on the defined categories of the questionnaire survey.

Y_d is the weight of stakeholder (d) years of experience based on the defined categories of the questionnaire survey;

N is the participants' total number.

To validate the robustness of this weighting scheme, a sensitivity check was conducted by adjusting the assigned weights upward and downward by ± 0.25 while maintaining their relative order. The recalculated prioritisation results under these alternative weighting scenarios exhibited only marginal variations in absolute scores, with no changes in the ranking of the most significant benefits. This confirms that the weighting structure is stable and that the prioritisation outcomes are not unduly sensitive to minor fluctuations in the assigned values.

3.5. The Assessment Model

Failure Mode and Effects Analysis (FMEA) was developed in 1949 and initially applied in military contexts [77]. It is widely recognised as a fundamental technique for system safety and risk management [78], particularly for identifying potential causes of failure, mitigating their effects, and prioritising system risks [79]. FMEA involves defining the modes and effects of each potential failure to ensure that all failure types are identified and ranked according to priority.

While FMEA has been extensively applied in healthcare, manufacturing, and transportation research to assess risks, failure modes, challenges, and barriers (e.g., [80–83]), its application in green-focused project management research remains limited. Nevertheless, the methodology can be extended to green projects to assess failures and their impact on project objectives, as low-level failures may propagate and generate significant higher-level issues [84].

In FMEA, rank calculation is determined based on the following parameters [85]:

Likelihood (L): the probability of failure occurrence.

Severity (S): the impact of failure on the project objectives.

Detection (D): the ability to identify a potential failure before its occurrence, which means how detectable the failure is while something is still done, also called detectability.

RPN: a number used to express the priority of the failure where

$$RPN = L \times S \times D \quad (2)$$

The study relies on FMEA likelihood, severity, and detection scales and also RPN ranking categories earlier developed and presented by John et al. [86]. The FMEA scales has five sub-scores (ranked from 1 to 5) which is aligned to the scales used for likelihood ('Very low' to 'Very high'), severity ('Very low' to 'Very high', and detection ('Very high' to 'Very low'). For the RPN ranking, there are five categories ('90–125'; '60–89'; '40–59'; '18–39', and '1–17'), which are aligned to ranks ranging from 'Extreme' to 'Low'.

The FMEA method offers a systematic and structured framework for analysing, identifying, and prioritising potential performance factors and challenges in complex projects, thereby supporting the implementation of strategies to reduce the risk of project failure [20]. In this study, these factors are framed as the perceived benefits, barriers, and challenges associated with project implementation. Its use is particularly appropriate for green technology projects, where stakeholder heterogeneity often results in divergent perceptions. Such projects frequently involve emerging technologies and environmental considerations, making the assessment and ranking of potential challenges and performance factors especially complex. FMEA addresses this complexity by evaluating attributes such as severity, likelihood of occurrence, and detectability, enabling project resources to be allocated to the factors most likely to have a substantial impact on project success.

Despite its advantages, the practical application of FMEA across different industries presents several drawbacks. For example, various failure modes may lead to the same Risk Priority Number (RPN), potentially obscuring the unique characteristics of each failure [87,88]. Consider two failure modes with O, S, and D values of 8, 10, 1 and 5, 4, 4,

respectively: both yield an identical RPN of 80 in the traditional FMEA method, suggesting equal importance and priority, although their actual impacts may differ significantly. Another limitation is that FMEA outcomes depend on the evaluator's experience, rendering the method susceptible to human error. Additionally, conventional FMEA does not account for interdependencies among different failure modes and their effects.

To overcome these limitations, FMEA can be combined with Fuzzy Set Theory (FST), offering an effective means of addressing the ambiguity inherent in human knowledge and decision-making [89,90]. Fuzzy set theory, introduced by Zadeh [91], has since been expanded with numerous enhanced methods for application across diverse fields, particularly in assessment studies (e.g., [92–94]). FST provides a robust mathematical framework for capturing uncertainties associated with imprecise or noisy data, as well as human cognitive processes such as reasoning and judgement. In this context, *fuzzy FMEA* offers a transparent, evidence-based approach for systematically managing stakeholder heterogeneity in green technology project implementation by highlighting the factors that most strongly influence both project performance and long-term environmental benefits.

Formally, a *fuzzy set* F on a referential U is characterized by a membership function $\mu_F: U \rightarrow [0, 1]$, where $\mu_F(u)$ denotes the grade of membership of u in F . In particular, $\mu_F(u) = 1$ reflects full membership of u in F , while $\mu_F(u) = 0$ expresses absolute non-membership. When $0 < \mu_F(u) < 1$, it indicates partial membership. This process comprises three subprocesses: *fuzzification*, inference, and *defuzzification*.

Fuzzification transforms precise input values into *fuzzy* values using predefined knowledge, relying on expert judgment to assign membership degrees within *fuzzy* sets through triangular, trapezoidal, or Gaussian membership functions [95]. A fuzzy inference system applies these principles to map inputs to outputs for decision-making or pattern recognition, using IF–THEN rules in two primary models: Mamdani and Assilian-type [96] and Takagi-Sugeno-type [97]. *Defuzzification* subsequently converts the fuzzy outputs back into precise values, typically employing methods such as the centre average, mean of maximum, or centre of gravity to determine the optimal crisp value [98].

The configuration of this study's assessment model, based on FMEA–FST, is summarised as follows. First, the L, S, and D levels were ranked according to the questionnaire survey results. Next, the RPN was calculated for each benefit, barrier, and challenge using Equation (1). MATLAB (Version 2024b) was then used to *fuzzify* the L, S, and D inputs employing triangular membership functions. Triangular forms were selected because they are computationally simple, widely adopted in risk and reliability studies, and effective for representing linguistic variables when expert judgments are available in approximate ranges [99]. Compared with trapezoidal functions, triangular shapes reduce parameterisation by requiring only three defining points, enhancing transparency and reproducibility of the analysis. Gaussian functions, while smooth, are more complex to calibrate and can introduce unnecessary subjectivity in defining spread parameters. Prior studies in construction and safety risk assessment also report that triangular functions strike a balance between interpretability and computational efficiency, making them suitable for the current context [90,100].

Mamdani-type inference controllers were applied to define system behaviour via IF–THEN rules. These controllers were chosen for their intuitive structure and suitability for expert system applications, particularly when the rule base is derived from subjective expert judgment. Finally, the outputs of the *fuzzy* inference system were defuzzified using the centroid method (centre of area) to obtain *Fuzzy Risk Priority Numbers* (F-RPNs) as crisp values. This *defuzzification* method was selected based on three key criteria [101]: (i) plausibility, producing values approximately at the centre of the area; (ii) disambiguation, yielding a unique output; and (iii) computational simplicity. The centroid method is widely

adopted because it is well-balanced, sensitive to the shape of the *fuzzy* output, produces consistent results, and is straightforward to implement [102].

4. Analysis

4.1. Focus Group

The focus group, comprising fifteen participants, was convened to identify the primary benefits of technology implementation, in this case, the e-payment digitalisation project, as well as the key challenges and barriers associated with the initiative. All participants were project management practitioners with relevant professional experience.

The discussion session included seven solution architects, each with sixteen to twenty-five years of work experience. Among them, four held a bachelor's degree (57.14%), one held a master's degree (14.28%), and two held doctoral degrees (28.57%) (see Table 3). The session also included three practitioners from primary contractor organisations, each with eighteen to twenty-two years of experience; two held a bachelor's degree (66.67%) and one held a master's degree (33.33%), with none holding a doctoral degree. Additionally, five project managers with fifteen to twenty years of experience in delivering green technology projects participated; four held a bachelor's degree (80%) and one held a master's degree (20%), with no doctoral degrees reported.

Table 3. The characteristics of the focus group experts.

Project Role	Number	Percentage	Av. Years of Experience	Educational Qualification		
				Bachelors	Masters	Doctorate
Solution architect	7	46.66%	21.3	57.41%	14.28%	28.57%
Project manager	5	33.34%	17.8	80%	20%	0%
Contractor	3	20.0%	20.4	66.67%	33.33%	0%

The primary objective of the focus group was to explore participants' perceptions of the project's benefits and to identify relevant barriers and challenges. Two guiding questions were developed to structure data collection (see Table 4).

Table 4. Guiding questions for focus group discussion.

No.	Guiding Questions
1	What do you think are the benefits of the <i>epayments</i> project?
2	What do you think are the key barriers and challenges hindering the efficient implementation of the <i>epayments</i> project?

Data analysis involved multiple steps, including translating the recorded sessions from Arabic to English, transcribing participants' responses, and summarising the transcripts. Responses were collated, and emerging outputs were coded and analysed using content analysis. To ensure both accuracy and comprehensiveness, this process was repeated to capture any additional relevant insights.

Project Implementation Benefits, Barriers, and Challenges

To achieve the research objectives, a focus group session was conducted to investigate the benefits, barriers, and challenges associated with implementing the *epayments* project. Table 5 presents the perceived project benefits as identified through the focus group discussion.

Table 5. The identified project benefits, barriers, and challenges.

Outputs of the Focus Group's Sessions	
Project implementation benefits	
B01	Enhance design capability
B02	Enhance project scheduling/sequencing
B03	Task clash detection
B04	Stimulate client usage
B05	Reduce disputes, claims and lawsuits
B06	Enhance productivity and technical competence of professional practice
B07	Enhance resource management and reduce environmental impact across the value chain
B08	Enhance project collaboration and communication
B09	Enhance health and safety performance
B10	Mitigate risks and reduce costs
B11	Streamline systems maintenance (i.e., changing, modifying, and updating relevant systems software)
Project implementation barriers and challenges	
C01	Lack of expertise in technology solutions (specific to <i>epayments</i>)
C02	Lack of client demand
C03	Lack of relevant related software codes and standards
C04	High cost of implementation
C05	Lack of support from senior management
C06	Lack of relevant training
C07	Potential less benefit for small sized and less complex projects
C08	Poor communication between stakeholders
C09	Incompatibility with industry and professional standard cost planning
C10	Poor project management culture.

To ensure that the identified project implementation benefits, barriers, and challenges were not contextually arbitrary, the outputs of the focus group discussions were cross-checked against findings from prior studies on green building and green technology adoption. The literature consistently highlights similar factors as critical to the success or failure of sustainable construction initiatives. Reported benefits include improved design and scheduling efficiency, enhanced collaboration, resource optimisation, and stronger health and safety performance. Conversely, high costs, lack of expertise, inadequate managerial support, insufficient demand, and poor communication have been widely recognised as barriers across both developed and developing contexts. This alignment confirms the rationality and relevance of the indicators presented in Table 5, reinforcing their applicability to the theme of stakeholder perceptions in green technology projects [20,21,103].

4.2. The Questionnaire

The survey yielded a total of 286 responses. Upon review, 27 responses were excluded because more than one-quarter of the questions were left unanswered, resulting in 259 usable responses.

Consistent with prior research on project stakeholder classification [23], respondents were first asked to indicate the option that best described their current role, based on project roles identified in previous studies [23,44]. Solution architects comprised 56% of the sample (145 respondents), followed by contractors at 20.8% (54 respondents) and project managers at 23.2% (60 respondents).

Regarding years of experience, 33.68% (38 respondents) of solution architects had 6–15 years of experience, 53.9% (61 respondents) had 16–25 years, and 12.38% (14 respondents) had more than 25 years. Among contractors, 76.6% (59 respondents) reported 16–25 years of experience, while 23.37% (18 respondents) had more than 25 years. For project managers,

10.14% (7 respondents) had 6–15 years of experience, 50.72% (35 respondents) had 16–25 years, and 39.10% (27 respondents) had more than 25 years of relevant experience.

In terms of educational qualifications, 52.21% (59 respondents) of solution architects held a bachelor's degree, 32.74% (37 respondents) held a master's degree, and 15.04% (17 respondents) held a doctorate. Among contractors, 61.03% (48 respondents) held a bachelor's degree, and 37.66% (29 respondents) held a master's degree. For project managers, 65.2% (45 respondents) held a bachelor's degree, 27.53% (19 respondents) held a master's degree, and 7.24% (5 respondents) held a doctorate.

4.3. Perceived Benefits of Green Technology Projects

A five-point Likert scale, ranging from 1 (“not important”) to 5 (“very important”), was employed to assess respondents’ perceptions of project benefits. Participants, including solution architects, project managers, and contractors, rated the various benefits of green technology projects using this scale. For instance, the benefit B10, “Mitigate risks and reduce costs,” was rated as “slightly important” by both solution architects and contractors, and as “moderately important” by project managers. Detailed results of the perceived benefits are provided in Table 6.

Table 6. Perceived benefits of green technology projects.

Project Benefits	Solution Architects		Contractors		Project Managers	
	Project Benefits Perception Score ¹	Project Benefits Rank	Project Benefits Perception Score ¹	Project Benefits Rank	Project Benefits Perception Score ¹	Project Benefits Rank
B01	62.0	1	19.0	8	28.0	9
B02	35.0	4	32.0	6	53.0	5
B03	39.0	3	43.0	4	79.0	1
B04	29.0	5	12.0	11	24.0	10
B05	26.0	7	48.0	2	68.0	3
B06	17.0	10	53.0	1	70.0	2
B07	24.0	8	44.0	3	57.0	4
B08	13.0	11	18.0	9	15.0	11
B09	42.0	2	25.0	7	49.0	6
B10	21.0	9	16.0	10	42.0	8
B11	27.0	6	35.0	5	38.0	7

¹ Refer to Equation (1) for the calculation method.

4.4. FMEA–FST Assessment Model

A five-point Likert scale, ranging from 1 (“very low”) to 5 (“very high”), was employed to assess the barriers and challenges of the project. Respondents were asked to rate each barrier, and challenge in terms of likelihood, severity, and detectability. Table 7 shows the FMEA output for the benefits, barriers, and challenges.

Table 7. FMEA for the barriers, and challenges.

Code	L		S		D		L × S × D	RPN	
	Linguistic Variable	Crisp Value	Linguistic Variable	Crisp Value	Linguistic Variable	Crisp Value		Linguistic Variable	Rank
C01	H	4.0	H	4.0	L	5.0	80.0	Significant	1
C02	V.H	5.0	H	4.0	M	3.0	60.0	Significant	4
C03	H	4.0	H	4.0	M	3.0	48.0	Major	5
C04	H	4.0	V.H	5.0	M	3.0	60.0	Significant	4
C05	V.H	5.0	V.H	5.0	M	3.0	75.0	Significant	2
C06	H	4.0	V.H	5.0	H	2.0	40.0	Major	7
C07	V.H	5.0	M	3.0	M	3.0	45.0	Moderate	6
C08	H	4.0	V.H	5.0	M	3.0	60.0	Significant	4
C09	H	4.0	H	4.0	H	4.0	64.0	Significant	3
C10	H	4.0	H	4.0	L	2.0	32.0	Moderate	8

H = High; V.H = Very high; M = Medium; L = Low.

The developed FMEA–FST model comprises of three input variables and one output variable with five attributes for each variable and one rule block (IF–THEN rule) (see Figure 2).

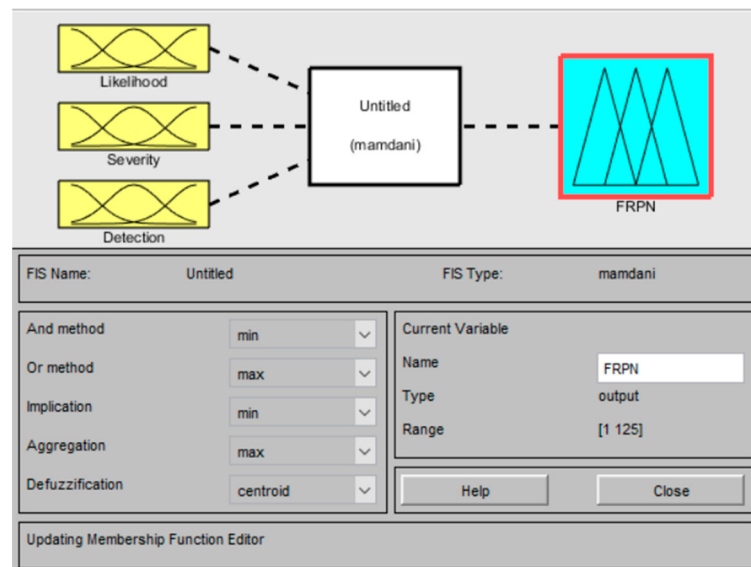


Figure 2. Fuzzy inputs and outputs variables.

The input variables for the *fuzzy* system are Likelihood (L), Severity (S), and Detection (D), each defined by five classes: Very High (V.H), High (H), Moderate (M), Low (L), and Very Low (V.L) (see Figure 3). The output variable of the system is the *Fuzzy Risk Priority Number* (F-RPN), with values categorised into five intervals: Low (L), Moderate (M), Major (M), Significant (S), and Extreme (E) (see Figure 4). Table 8 presents the fuzzy set representation for the levels of Likelihood, Severity, and Detection.

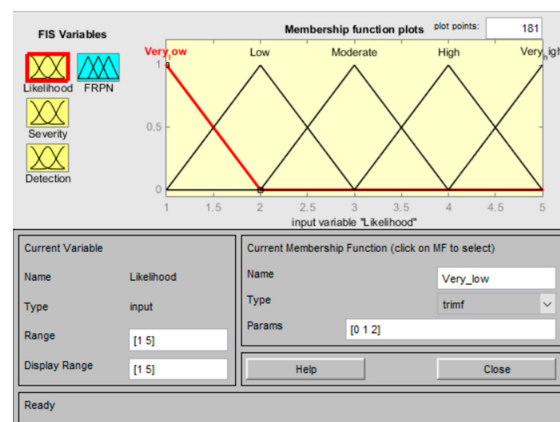


Figure 3. Membership function for the input variable.

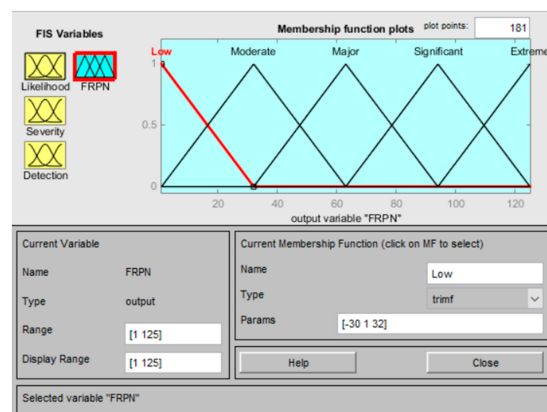
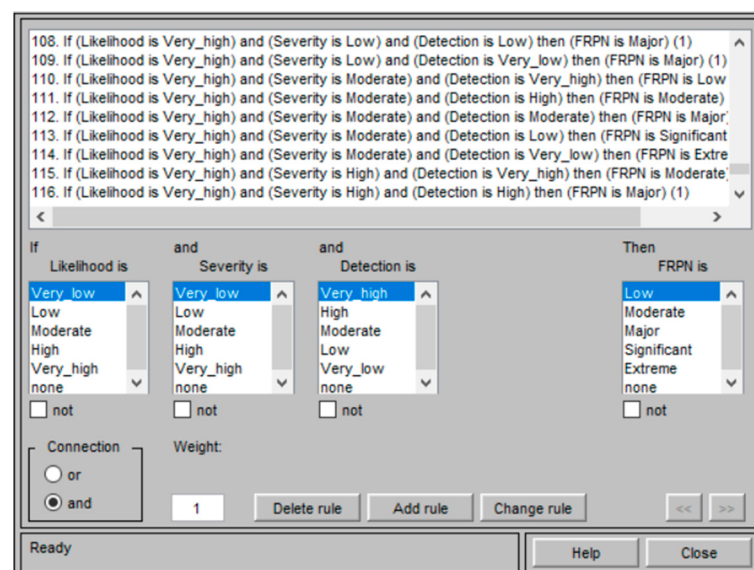


Figure 4. Membership function for the output variable.

Table 8. Fuzzy set representation for FEMA-Fuzzy linguistic terms.

Project Implementation Barriers	L			S			D		
	Linguistic Variable	Triangular Number	Supporting Interval	Linguistic Variable	Triangular Number	Supporting Interval	Linguistic Variable	Triangular Number	Supporting Interval
C01	H	(3,4,5)	$3 \leq x \leq 5$	H	(3,4,5)	$3 \leq x \leq 5$	L	(1,2,3)	$1 \leq x \leq 3$
C02	V.H	(4,5)	$4 \leq x \leq 5$	H	(3,4,5)	$3 \leq x \leq 5$	M	(2,3,4)	$2 \leq x \leq 4$
C03	H	(3,4,5)	$3 \leq x \leq 5$	H	(3,4,5)	$3 \leq x \leq 5$	H	(3,4,5)	$3 \leq x \leq 5$
C04	H	(3,4,5)	$3 \leq x \leq 5$	V.H	(4,5)	$4 \leq x \leq 5$	M	(2,3,4)	$2 \leq x \leq 4$
C05	V.H	(4,5)	$4 \leq x \leq 5$	V.H	(4,5)	$4 \leq x \leq 5$	M	(2,3,4)	$2 \leq x \leq 4$
C06	H	(3,4,5)	$3 \leq x \leq 5$	V.H	(4,5)	$4 \leq x \leq 5$	H	(3,4,5)	$3 \leq x \leq 5$
C07	V.H	(4,5)	$4 \leq x \leq 5$	M	(2,3,4)	$2 \leq x \leq 4$	M	(2,3,4)	$2 \leq x \leq 4$
C08	H	(3,4,5)	$3 \leq x \leq 5$	V.H	(4,5)	$4 \leq x \leq 5$	M	(2,3,4)	$2 \leq x \leq 4$
C09	H	(3,4,5)	$3 \leq x \leq 5$	H	(3,4,5)	$3 \leq x \leq 5$	H	(3,4,5)	$3 \leq x \leq 5$
C10	H	(3,4,5)	$3 \leq x \leq 5$	H	(3,4,5)	$3 \leq x \leq 5$	L	(1,2,3)	$1 \leq x \leq 3$

The mapping between the input and output variables was established using fuzzy IF–THEN rules. A total of 125 rules were employed, providing a robust framework for decision-making and pattern recognition. The rule base was generated through an exhaustive combination approach, ensuring that all possible interactions were systematically captured without bias. This strategy aligns with previous *fuzzy* research in construction and engineering, where comprehensive rule sets have been adopted to enhance coverage and consistency [90,99,100,104]. Examples of the IF–THEN rules used in the FMEA–Fuzzy assessment system are presented in the *fuzzy* Rule Editor in Figure 5. The corresponding rankings of benefits, barriers, and challenges based on their F-RPN values are summarised in Table 9.

**Figure 5.** Fuzzy Rule Editor.**Table 9.** Ranking of the benefits, barriers, and challenges FRPNs.

Project Implementation Barriers	F-RPN	Rank
C01	80.2	4
C02	83.9	2
C03	56.7	9
C04	83.1	3
C05	89.8	1
C06	71.7	7
C07	53.5	10
C08	75.0	6
C09	74.5	5
C10	63.0	8

The relationship between the input variables (L, S, and D) and the output variable (F-RPN) is illustrated using a Surface Viewer in Figure 6. The Surface Viewer provides a three-dimensional mapping tool, where two inputs are plotted against a single output. Since this study involves three input variables (L, S, and D), the surface plot is generated by holding one input constant. In this analysis, the surface represents L, S, and F-RPN, with D held constant.

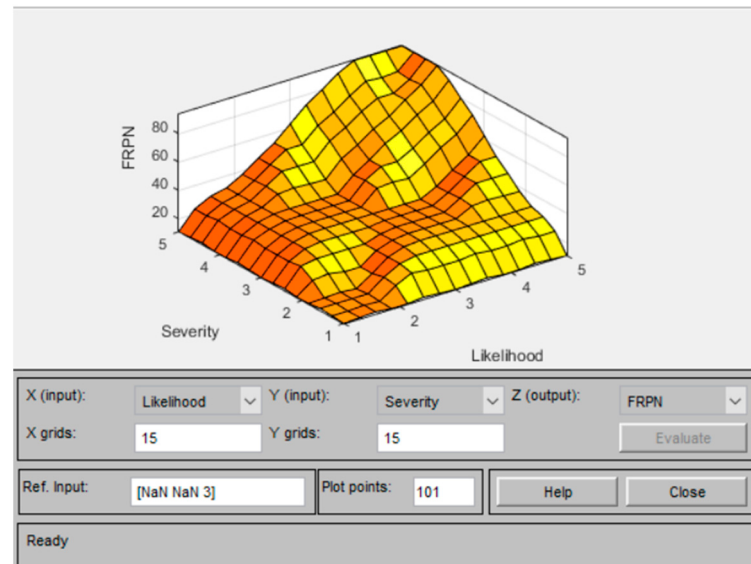


Figure 6. Surface Viewer for barriers and challenges.

A point at the coordinate (0,0) corresponds to a scenario in which L and S are very low while D is very high, resulting in a low F-RPN value. This area of the plot is represented by cool colors like blue and green, visually reinforcing the low risk level. Conversely, the point at (5,5) represents a scenario in which L and S are very high and D is very low, producing an extreme F-RPN value. The surface plot illustrates the relationship between L, S, D and FRPN. Warmer colors (yellow to orange) represent regions with higher FRPN values, indicating more critical barrier combinations, while cooler colors (light orange to darker shades) correspond to lower FRPN values, representing less significant risks.

Examination of the surface plot indicates that the maximum F-RPN of 89.8 was obtained when both likelihood and severity inputs reached their highest values of 5.0, highlighting the combined effect of high likelihood and severity on prioritisation outcomes for barriers and challenges.

5. Findings

The findings are presented by focusing on two key areas relating to the (i) perceived benefits of green technology projects and the (ii) outcome of the FMEA–FST assessment model.

5.1. Perceived Benefits

Regarding the perceived benefits of green technology projects, B01 (*“Enhance design capability”*) was rated as highly valuable by solution architects (PS = 62.2; ranked 1), whereas project managers and contractors considered it less important (PS = 28.0, ranked 9; PS = 19.0, ranked 8, respectively). This aligns with expectations, as technology facilitates green design modifications and coordination [33,105].

For B02 (*“Enhance project scheduling/sequencing”*), project managers reported the highest perception (PS = 53.0; ranked 5), with solution architects and contractors ranking it fourth and sixth, respectively. This reflects differences in stakeholder priorities, con-

sistent with prior research demonstrating how project manager heterogeneity and perception incongruence can influence assessments of project outcomes, including in green projects [13,24,106,107].

B03 (*“Task clash detection”*) received the highest perceived value from project managers (PS = 79.0; ranked 1), followed by contractors (PS = 43.0; ranked 4) and solution architects (PS = 39.0; ranked 3). This corresponds with the project manager’s primary responsibility for day-to-day project delivery within constraints [108]. The use of technology enhances operational performance during green project implementation [108,109], supporting these rankings.

Perceptions for B04 (*“Simulate client usage”*) were low across all groups: solution architects PS = 29.0 (ranked 5), project managers PS = 24.0 (ranked 10), and contractors PS = 12.0 (ranked 11).

B05 (*“Reduce disputes, claims, and lawsuits”*) was rated highly by project managers (PS = 68.0; ranked 3), reflecting the high incidence of project disputes reported in the UAE [110,111]. Contractors also rated it highly (PS = 48.0; ranked 2), whereas solution architects assigned it lower importance (PS = 26.0; ranked 7), likely because disputes typically arise during the implementation phase due to unique project challenges and external factors such as software security issues.

B06 (*“Enhance productivity and technical competence”*) was rated highest by project managers (PS = 70.0; ranked 2) and contractors (PS = 53.0; ranked 1), reflecting the positive impact of green technology on productivity and management performance [112]. Solution architects rated this benefit lower (PS = 17.0; ranked 10).

B07 (*“Enhance resource management and reduce environmental impact across the value chain”*) was highly ranked by project managers (PS = 57.0; ranked 4) and contractors (PS = 44.0; ranked 3), consistent with the role of 3D modelling in facilitating complex logistics planning [113,114]. Solution architects rated this benefit lower (PS = 24.0; ranked 8), suggesting limited influence in this area.

Perceptions of B08 (*“Enhance project collaboration and communication”*) were uniformly low across all groups, despite technology being a key facilitator of collaboration [115]. B09 (*“Enhance health and safety performance”*) was rated most beneficial by project managers (PS = 49.0; ranked 1) and solution architects (PS = 42.0; ranked 2), while contractors perceived it as less important (PS = 25.0; ranked 7).

B10 (*“Mitigate risks and reduce costs”*) ranked highest among project managers (PS = 42.0; ranked 8), highlighting technology’s role in risk management during project implementation [116]. Solution architects and contractors perceived lower benefits, indicating potential discrepancies in perceived effectiveness.

Finally, B11 (*“Streamline systems maintenance”*) received low perception levels across all groups, with project managers scoring the highest (PS = 38.0; ranked 7). This was unexpected, particularly for solution architects, whose expertise may have been underutilised during implementation.

Overall, these findings suggest that the FMEA model based on Fuzzy Set Theory (FST) provides a more representative assessment of benefits, barriers, and challenges than the classical FMEA approach. By distinguishing the influence levels of these factors, project stakeholders can gain actionable insights for managing project outcomes more effectively.

5.2. Outcome of the FMEA–FST Assessment Modelling

The assessment of challenges and barriers indicated that C05 (*“Lack of support from senior management”*) exhibited a very high likelihood, very high severity, and moderate detectability. Using the FMEA–FST assessment model, C01 (*“Lack of expertise in technology solutions specific to technology-driven projects”*) initially emerged as the failure mode with the highest overall risk, followed by C05 (*“Lack of support from senior management”*), C09 (*“Incompatibility with*

industry and professional standard cost planning”), C02 (“Lack of client demand”), C04 (“High cost of implementation”), C08 (“Poor communication between stakeholders”), C03 (“Lack of relevant software codes and standards”), C07 (“Potentially lower benefit for small and less complex projects”), C06 (“Lack of relevant training”), and C10 (“Poor project management culture”).

However, when analysing the F-RPN rankings, C05 became the highest-risk failure mode (rank 1), followed by C02 (rank 2), C04 (rank 3), C01 (rank 4), C09 (rank 5), C08 (rank 6), C06 (rank 7), C10 (rank 8), C03 (rank 9), and C07 (rank 10). Comparing conventional FMEA with Fuzzy FMEA, the conventional RPN rankings were $C01 > C05 > C09 > C02, C04, C08 > C03 > C07 > C06 > C10$, with C01 holding a critical position at $RPN = 80.0$. After applying Fuzzy FMEA, C01 ranked fourth with an F-RPN of 80.2, while C05 became the top priority with an F-RPN of 89.8. The final Fuzzy FMEA ranking of the factors was: $C05 > C02 > C04 > C01 > C09 > C08 > C06 > C10 > C03 > C07$.

The study also highlighted that identical linguistic expressions for likelihood, severity, and detectability could produce the same conventional RPN values. For example, C04 and C08 shared an RPN of 60.0, with $L = 4$ (high), $S = 5$ (very high), and $D = 3$ (moderate). Similarly, C02 shared the same detection value ($D = 3$) but differed in likelihood ($L = 5$) and severity ($S = 4$), resulting in identical conventional RPN rankings (rank 4) for C02, C04, and C08. Such similarities could create ambiguity for stakeholders, potentially leading them to rely on intuition rather than the ranking methodology. In contrast, the defuzzified outputs (F-RPNs) resolved these ambiguities: C04 = 83.1 (rank 3), C08 = 75.0 (rank 6), and C02 = 83.9 (rank 2), providing a clearer and more reliable prioritisation of benefits, barriers, and challenges.

6. Discussion

The implementation of green technology initiatives has consistently demonstrated vulnerability to failure, as reflected in numerous identified benefits, challenges, and barriers. The impact of these factors is further complicated by stakeholder heterogeneity, which introduces varying perspectives and priorities within project environments. Considering the consequences associated with such failures, this study sought to empirically investigate and rank the benefits, challenges, and barriers deemed most significant by stakeholders during the implementation phase, with particular attention to differences arising from stakeholder roles.

Two research questions guided this investigation. The first aimed to identify the benefits, challenges, and barriers considered important during the execution of green technology projects. The second examined how stakeholders prioritise these factors differently according to their roles within such projects.

To address the first research question (RQ1: *What are the benefits, challenges, and barriers considered important by stakeholders during the implementation of green technology projects?*), the FMEA–FST assessment model was employed. This analysis identified ten critical factors: “Lack of support from senior management”, “Lack of client demand”, “High cost of implementation”, “Lack of expertise in technology solutions specific to technology-driven projects”, “Incompatibility with industry and professional standard cost planning”, “Poor communication between stakeholders”, “Poor communication between stakeholders”, “Lack of relevant training”, “Poor project management culture”, “Lack of relevant software codes and standards”, and “Potentially lower benefit for small and less complex projects”. Among these, “Lack of support from senior management” emerged as the most critical factor, highlighting the centrality of executive/senior leadership backing in project success.

These findings align closely with prior studies on project prioritisation in green technology contexts [117–122]. For instance, Hwang and Ng [117] identified major challenges in green technology delivery, particularly those related to costs, while Köhler [121] emphasised the need to manage differing stakeholder intentions and the pivotal role of senior

management in achieving sustainability objectives. Overall, the results for RQ1 underscore the importance of executive support as a key determinant of successful technology adoption, echoing prior research highlighting leadership involvement as critical for favourable project outcomes [123–125].

Regarding the second research question (RQ2: *What differences exist in how stakeholders prioritise benefits, challenges, and barriers based on their roles in green technology projects?*), the findings demonstrate that most stakeholders maintained divergent views on perceived benefits, challenges, and barriers. An exception was the consistent prioritisation of “*Simulate client usage*”. This outcome was unexpected, as simulation, particularly when enhanced with virtual reality (VR), provides project teams with a comprehensive understanding of system operation and feasibility scenarios. The result indicates potential underutilisation of technology in supporting immersive simulations and collaborative processes, underscoring the need for further stakeholder engagement and training.

Project managers placed strong emphasis on project-specific elements, such as “*Enhance project scheduling/sequencing*” and “*Task clash detection*”, both directly tied to project delivery. These findings support earlier studies [13–24], which concluded that project managers typically favour task-oriented perspectives over boundary-spanning ones, largely due to the perception that these factors exert a more immediate effect on project outcomes.

While previous studies suggested some degree of stakeholder alignment in evaluating project performance and outcomes [13–23], the present findings indicate limited congruence in stakeholder perceptions of *benefits*, *challenges*, and *barriers*, suggesting substantial differences likely driven by disciplinary interests [126]. Some level of alignment was anticipated given the degree of collaboration required among stakeholders; however, the current evidence indicates that differences in green technology projects are more pronounced than initially presumed. At a minimum, alignment between project managers and solution architects was expected, considering their frequent interactions and shared interest in factors primarily influenced by internal project processes.

One possible explanation for this lack of alignment is the distinctive nature of green technology projects. Such projects emphasise efficiency, aiming to minimise resource consumption while maximising output, thereby reducing waste and promoting sustainability [16]. Unlike traditional projects, which often function as vehicles for implementing established strategies [127], green technology projects are frequently employed to advance broader sustainability agendas and operate within wider social contexts, often embedded in communities, where external influences significantly shape outcomes [121,128,129]. Moreover, green projects are characterised by the centrality of technology [108,130,131].

Beyond differences in stakeholder prioritisation, the *fuzzy* FMEA–FST analysis revealed that challenges and barriers were assessed with greater precision than benefits. This reflects a satisficing orientation: once minimum standards are achieved, stakeholder attention shifts to benefits as the primary indicators of project success. In green technology contexts, barriers are typically evaluated against technical objectives, such as functionality, whereas benefits are assessed more subjectively in terms of client value.

7. Conclusions

Motivated by recognition in the literature of how stakeholder heterogeneity and incongruence affect the performance of green technology projects, this study set out to empirically assess and prioritise the benefits, challenges, and barriers considered most significant during project implementation, with particular focus on stakeholder differences (i.e., heterogeneity). To conduct the research, insights from a focus group of fifteen project stakeholders were first used to identify key barriers. These were then ranked using survey responses from 286 stakeholders based in the United Arab Emirates.

The novelty of this research lies in its ability to prioritise such factors through a tailored *fuzzy* FMEA–FST model, which was applied to evaluate the benefits, challenges, and barriers stakeholders regarded as critical during the implementation of green technology projects. Ten major factors were identified. Among these, “*Lack of support from senior management*” emerged as the most critical across all categories, while “*Potential lower benefits for small or less complex projects*” was ranked the least important.

The study also examined how stakeholders’ roles influenced the prioritisation of benefits, challenges, and barriers. Results revealed substantial variation in the importance assigned to these factors, highlighting pronounced differences among stakeholder groups.

7.1. Practical Implications

In terms of practical implications, the study indicates that, unless deliberate attention is given, stakeholders are unlikely to maintain consistent views regarding the importance of benefits, barriers, and challenges in green technology projects. Due to stakeholder heterogeneity, complete consensus on these factors is unrealistic; however, engaging stakeholders in a broadly aligned manner can help reconcile divergent expectations. As no universal list of perceived benefits, challenges, and barriers exists for the implementation of green technology projects, this study provides a structured requirements specification that practitioners can use to align stakeholder interests and promote a more balanced understanding of project objectives. The study also shows that project managers placed greater emphasis on project-specific issues than on boundary-spanning concerns, highlighting the need to ensure that long-term project interests are not underrepresented. Practitioners are therefore encouraged to pay closer attention to the perspectives of a wider range of stakeholders, particularly in areas where differences among stakeholder groups are likely to be most significant.

7.2. Theoretical Implications

This study contributes to both the literature on green technology implementation and the broader field of project stakeholder management. It also informs the ongoing debate on performance evaluation criteria for green technology projects by clarifying the implementation factors that multiple stakeholders consider when assessing the importance of benefits, challenges, and barriers. More specifically, the study advances project management theory by applying stakeholder theory to examine incongruence and multiplicity in the evaluation of performance factors within green projects. It identifies 21 factors, 11 benefits and 10 barriers/challenges, that stakeholders use to measure performance, underscoring their collective significance. By uncovering substantial differences in the perceived importance of these factors across stakeholder groups and highlighting common framing biases, the study extends the green technology stakeholder literature by explaining why stakeholders often diverge in their evaluations and rarely share identical perspectives. Its novelty lies in the prioritisation of these factors through the tailored *fuzzy* FMEA–FST model.

7.3. Limitations and Future Research

This research is subject to several limitations. First, additional secondary benefits and barriers may exist that were not captured. As performance salience can vary across the project lifecycle, future research should investigate lifecycle effects and compare salience across different project types, which may influence performance dimensions in distinct ways. Second, temporal and typological effects were not examined. These may be particularly salient for retrospective evaluations, where self-validation and blame displacement shape recollections of benefits and failures. For ongoing projects, by contrast, salience may be shaped by the pressures of complexity and uncertainty. Third, the stakeholder group engaged in this study was limited in scope. Extending the research to a broader range of stakeholders could yield deeper insights into performance evaluations. Future studies

could also examine how practitioner roles and project manager personality traits influence the prioritisation of benefits, barriers, and challenges. Such inquiry requires more refined performance frames that are attuned to these dimensions. Finally, representativeness is constrained by the use of snowball sampling, which, while pragmatic, limits generalisability. The absence of a comprehensive sampling frame of project professionals in the UAE compounded this challenge. To address this, future studies could collaborate with professional bodies such as PMI Khaleeji (UAE), which are well positioned to facilitate broader survey dissemination.

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